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ERRATA

Page	12	line	9	for '*europea*'	read '*europaea*'
	54		31	,, '*gramineum*'	,, '*graminum*'
	54		45	,, '*Cyclogonium*'	,, '*Cycloconium*'
	61		49	,, '*muranium*'	,, '*murinum*'
	75		16	,, '*Ersiphe*'	,, '*Erysiphe*'
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		and	4	,, '*sempervivens*'	,, '*sempervirens*'
	96	line	42	,, '*Cytosporina*'	,, '*Cytospora*'
	109		30	,, '*kopkii*'	,, '*kopkei*'
	122		48	,, '*chromatosporum*'	,, '*chomatosporum*'
	156		15	,, '*Hemeleia*'	,, '*Hemileia*'
	159		13	,, '*gramineum*'	,, '*graminum*'
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	243		34	,, '*Leontodontis*'	,, '*Leontodon*'
	322		41	,, '*Tillettia*'	,, '*Tilletia*'
	334		24	,, 'Tisdale (W. T.)'	,, 'Tisdale (W. H.)'
	356		27	delete 'of'	
	357		44	for '*atropurpurem*'	,, '*atropurpureum*'
	361		2	,, 'rot'	,, 'rust'
	416		14	,, '*Cercosporella*'	,, '*Cercospora*'
	471		20	,, '*Reichanst*'	,, '*Reichsanst*'
	497		45	,, '*gramineum*'	,, '*graminum*'
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	571		12	,, 'Obliteration'	,, 'Lignification'
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IMPERIAL BUREAU OF MYCOLOGY

REVIEW

OF

APPLIED MYCOLOGY

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SPIERENBURG (DINA). **Een onbekende ziekte in de Iepen. II.** [An unknown disease of Elms. II.]—*Versl. en Meded. Plantenziektenkundigen Dienst te Wageningen*, 24, 31 pp., 1 fig., 4 pl., 1922.

The unknown disease of elms, which caused so much damage in Holland in 1920 [see this *Review*, i, 8, p. 277], continued its ravages in 1921. The districts mainly affected were Brabant, the Betuwe and various localities in the south, Rotterdam and its environs (where the disease was extremely prevalent and severe), Alkmaar, and Amsterdam. Sporadic cases were reported from the north-eastern provinces, where the infection appears to be in an incipient stage. Attacks are also reported from France [see this *Review*, i, 10, p. 334] and Belgium. According to official German statements, elms in Germany are not affected, but Dutch visitors to the Rhine districts believe that the disease is also present in that area. It has not, however, actually been seen in any foreign country by the officials attached to the Dutch Phytopathological Service.

The following are the principal varieties attacked: *Ulmus campestris latifolia, U. monumentalis, U. hollandica, U. rupelli, U. campestris suberosa, U. americana*, and *U. campestris aurea*. *U. vegeta* appears to be immune, but this variety is not adapted to street planting.

Affected trees may be divided into three groups according to the symptoms manifested: (*a*) Comparatively young trees in which the withering of the top leaves quickly spreads downwards, forming a sharp contrast to the green leaves of the lowest branches. This form of the disease appears to be fatal. (*b*) Large, old trees in which one of the branches suddenly withers, to be followed within a few weeks by others and then by the top. (*c*) Chiefly old trees which appear to be more or less permanently affected. The leaves emerge slowly in the spring and remain small. They turn colour prematurely, dry up about the middle of July, and fall early. Throughout the summer the foliage is scanty.

Trees, especially old ones, may show wilting of the shoots early in the year, and later burst into new foliage which, however,

rapidly withers. Such trees rarely recover. So-called water-shoots may often be seen on the trunk.

Severely affected trees as a rule develop buds for the following year on their shoots, but the buds are small, and appear dried up. In milder cases, flower buds are formed as though to continue the species by seed.

Very old trees appear to be more resistant than the younger ones, but this seeming immunity may be due to their larger food reserves and available water-conducting tissue. In 1921 the disease was much more prevalent in nurseries than in the previous year. Usually the youngest trees attacked are not less than four years old, but cases have again been observed in trees one year old.

In addition to the discoloration of the wood already noted [see earlier abstract], a discoloration of the bast in the shoots of young trees has been observed, but not frequently enough to associate this symptom with the disease. Sometimes a brown ring appears between the bast and the wood of the branches which, in such cases, die rapidly. A very thin layer of healthy wood is usually present beyond the last discoloured tissue. The latter does not always extend the whole length of the branch, but it is always present in the top branches of young diseased trees and in the thin branches and roots of old ones.

Microscopical examination showed that the discoloured tissues are plainly recognizable and always occur in the previous year's wood. The medullary rays usually contain large starch grains which, in the affected parts, become brown. Spots are seen in the walls of all the ligneous elements. Tyloses are common in the vessels. The discoloration of the wood is irregular, very dark stripes occurring next to lighter areas.

In the winter of 1921–22 many further cases of attack by *Eccoptogaster scolytus* were noticed. The larvae of flies of undetermined species were also found under the bast. *Typhlocyba* and *Oribata* were of frequent occurrence, whilst *Anthocoptes* sp. were found on 1921 shoots.

The following fungi have been isolated from diseased tissues:—a form with *Cephalosporium* and *Graphium* stages, *Fusarium* sp., *Monilia* sp., *Botrytis* sp. (in 1920 but not 1921), *Dematium* sp., *Ramularia* sp., *Phoma* sp., and also bacteria.

From non-discoloured wood were isolated: *Fusarium* sp., *Cytosporina* sp., and *Dematium pullulans* (?). In spite of the rapid development of the *Cephalosporium* form in culture, the mycelium of this fungus is never visible in the tissues of the discoloured wood.

Inoculations with *Cephalosporium* (with or without the *Graphium* stage) on two and three year old elms produced the discoloration in the wood, and cultures of such wood always yielded the same fungus again. Other fungi also produced discoloration of the wood, but could not be re-isolated. It has not been found possible to decide which organism is responsible for the disease or whether the disease is an infectious one. The writer states that some extreme influence of a more or less general character appears to be predisposing the elms to the attacks of fungi and bacteria which are the immediate cause of the disease.

No control measures can be definitely recommended. Drastic pruning appears to render the trees susceptible to the disease.

HEDGCOCK (G. G.), HAHN (G. G.), & HUNT (N. R.). **Two important Pine cone rusts and their new Cronartial stages.**—*Phytopath.*, xii, 3, pp. 199–122, 2 pl., 1922.

The paper is divided into two parts. The first by Hedgcock and Hahn, is entitled '*Cronartium strobilinum* (Arthur) Hedgc. and Hahn, comb. nov.' This rust has been known in Florida and Mississippi as *Caeoma strobilina* Arth. on *Pinus palustris* and *P. heterophylla*, and frequently exerts a very damaging effect on the reproduction of these pines. Immature, first year cones are infected and swell up, produce pycnidia and aecidia, then usually fall. Artificial inoculations were successful in producing uredosori, sometimes also with teleutosori, on three species of *Castanea* and twenty-five species of *Quercus*. The fungus is fully described.

The second part by Hedgcock and Hunt is entitled '*Cronartium conigenum* (Pat.) Hedgc. and Hunt, comb. nov.' Patouillard described *Caeoma conigenum* from Mexico on cones of an undetermined pine. An examination of portions of the type shows that the fungus is morphologically a *Peridermium*, and the host was probably *Pinus chihuahuana*. The fungus has been found in Arizona on this host, and causes damage to the cones. Inoculation tests were successful on three species of *Castanea* and seventeen species of *Quercus*.

SPAULDING (P.). **Investigations of the White-Pine blister rust.**—*U.S. Dept. of Agric. Bull.* 957, 90 pp., 6 pl. (1 col.), 13 figs., 1922.

In this comprehensive monograph the author endeavours to present all the information at present available on the white pine blister rust. The work is divided into the following sections: The origin and distribution of *Cronartium ribicola*, in which the theory of the Asiatic origin of the disease is discussed and supported; an account of its hosts, giving a complete list of all the species of *Pinus* and *Ribes* naturally attacked or capable of artificial infection, with details of their relative susceptibility as far as known; the life-history of the parasite, comprising the *Peridermium* stage on pines and the *Cronartium* stage on *Ribes*, with a very full account of the different types of infection, methods of dissemination, germination and viability of the spores, &c.; the overwintering of the fungus on pines and on *Ribes*; important dates in its life-history; and the control of the disease.

The author points out that there are certain significant features in the life-history of *C. ribicola* and in its relation to the environment which have an influence on its control. The pycnospores (spermatia) are apparently functionless; the aecidiospores and uredospores are not known to infect pines but do infect *Ribes*; while the sporidia produced by the teleutospores are not known to infect *Ribes* but do infect pine. The wind is the chief agent of distribution, the aecidiospores being capable of infecting *Ribes* leaves several miles away from their source. The viability of the uredospores appears to be soon lost, so that infection by them is

more limited in distance. The sporidia are still more frail and, as a rule, can only carry infection to a distance of 100 to 600 yards. The aecidiospores produced by the overwintered mycelium in the pine bark are the principal source of infection of *Ribes* leaves in the spring, the resulting uredospores still further disseminating the disease. High atmospheric humidity is an essential for the germination of any of the spore forms.

The present status of the control of the white pine blister rust in North America may be summed up as follows:—Eradication of *C. ribicola* is impossible except in small, isolated, advance infections. As a national problem control is the only feasible measure. Protection of uninfected or sparsely infected areas by the enforcement of the present Federal quarantines is necessary, since this disease is distributed to great distances only by means of infected nursery stock. The western forests of white pines can be protected from the blister rust for an indefinite period by the rigid enforcement of the Mississippi Valley quarantine. A single diseased shipment may undo all attempts to restrict it to the eastern forests.

A very full bibliography of 180 titles is appended.

White-Pine blister rust in the Western United States.—*U.S. Dept. Agric. Circ.* 226, 7 pp., 9 figs., (5 col.), 1922.

White pine blister rust (*Cronartium ribicola*), which has for some years past been ineradicably established in New England, New York, and the Lake States, was discovered in the autumn of 1921 to have invaded western British Columbia [see this *Review*, i, p. 455] and the Puget Sound region of Washington State. The valuable forests of western white pine (*P. monticola*) and sugar pine (*P. lambertiana*) are now directly threatened by this destructive disease, and can only be saved by the rigid enforcement of the Federal quarantines which restrict the movements of five-needle pines, currants, and gooseberries. The co-operation of all is invoked to assist in finding and destroying any outbreaks of the disease in *Ribes* or pines. The planting of black currants is deprecated.

Approximately three-quarters of the commercial five-needle pine stand of the United States is stated to be in the western forests.

SPAULDING (P.). **Viability of telia of Cronartium ribicola in early winter.**—*Phytopath.*, xii, 5, pp. 221–224, 1922.

Experiments have been carried out at Bethel, Vermont, to determine how late in the season the teleutospores of *Cronartium ribicola* may remain viable under natural conditions.

Vigorous leaves of five species of *Ribes*—*nigrum*, *odoratum*, *americanum*, *rotundifolium*, and *cynosbati*, bearing abundant teleutosori, were enclosed in mosquito bags and hung out of doors on 26th September, 1921. Germination tests were made at intervals until 8th December, when the experiment ended. The results obtained showed that while teleutospores on *R. cynosbati*, *rotundifolium*, and *odoratum* had almost reached their limit of viability by 8th December, those of *R. americanum* retained considerable vigour and those of *R. nigrum* were almost as vigorous as when first collected. It has long been recognized that *R. nigrum* is far the most dangerous species of *Ribes* known in relation to the blister rust of white pine.

Further tests showed that leaves killed suddenly by frosts bore teleutospores of maximum germinating power, and attention is called to the fact that the danger of infection is increased by the ability of teleutospores to germinate in winter, when the temperature rises a few degrees above freezing, although it is not known whether the pines are susceptible at this season.

RATHBUN (ANNIE E.). **Root rot of Pine seedlings.**—*Phytopath.*, xii, 5, pp. 213–220, 1 fig., 1922.

For several years coniferous seedlings, too old to succumb to ordinary damping-off, have been known to suffer from late damping off and root rot. Inoculation experiments were carried out on *Pinus resinosa* and *P. banksiana* to confirm the conclusion arrived at by field observations, namely that damping-off fungi may be responsible for these root injuries. The fungi tested were: *Pythium de Baryanum*, *Corticium vagum*, *Fusarium* spp., *Botrytis* spp., *Phomopsis juniperovora*, and *Rheosporangium aphanidermatus*. The inoculum on rice mush was applied directly to the roots, which in most cases were again covered with sterilized sand. Root rot developed to a slight extent in the controls. The inoculations were too few to permit more than a comparison of the virulence of different genera.

P. de Baryanum and the *cinerea* type of *Botrytis* caused decay to most of the roots. A small sclerotial form of *Botrytis*, however, produced no injury. *C. vagum* caused a decided increase in the amount of root rot compared with the controls. The results with *Fusarium* spp. were variable but on the whole root rot was somewhat increased. *R. aphanidermatus* caused no appreciable decay, but *P. juniperovora* produced considerable decay in one trial with twenty seedlings. The latter result suggests the possibility that under favourable conditions other fungi as well as damping-off parasites may cause root rot.

The results of these very artificial tests, though in no sense representative, may be taken as an indication that the root decay of pine seedlings is at least partly due to damping-off fungi.

MEIER (F. C.), DRECHSLER (C.), & EDDY (E. D.). **Black rot of Carrots caused by Alternaria radicina n. sp.**—*Phytopath.*, xii, 4, pp. 157–166, 2 figs., 1 pl., 1922.

During 1918–19 complaints were made from Long Island of the heavy losses by decay of carrots in transit and storage. Later investigations have shown that other localities in the States of New York, Massachusetts, and possibly Pennsylvania are also affected.

The trouble is characterized by a progressive softening and blackening of the tissues of the root, infection frequently starting at the crown and extending down the core, but sometimes also originating at other points.

A fungus was easily isolated from diseased carrots and proved to be pathogenic both on the root and on the foliage. Search for affected foliage in the field was not successful. The fungus, a new species of *Alternaria*, is named *A. radicina* and is fully described.

A close comparison is made with a disease of the foliage of carrots caused by *Macrosporium carotae* Ell. and Lang. The latter, however, is an obligate parasite which attacks vigorous plants, while *A. radicina* is a facultative parasite affecting mature tissues, especially those of more or less bruised or wounded roots during harvesting or storage.

VOGLINO (R.). **Servizio di segnalazione degli attacchi di Plasmopara viticola nel 1921 nelle Province di Torino, Cuneo, Novara.** [The system of forecasting attacks of *Plasmopara viticola* in 1921 in the Provinces of Turin, Cuneo, and Novara.] —*Nuovi Ann. Min. Agric.*, ii, 1, pp. 72–80, 1922.

Meteorological conditions likely to influence epidemics of fungous diseases of the vine were recorded at various localities and at altitudes ranging from 230 to 550 m. in the provinces of Turin, Cuneo, and Novara, and the observations forwarded to the central Phytopathological Station at Turin. From the data furnished by the local observatories, fortnightly bulletins were compiled containing particulars of the maximum and minimum temperatures, atmospheric pressure, atmospheric and soil humidity, rainfall, winds, fogs and dews, cloud, &c. All the members of the observatory staffs were instructed to pay special attention to the rainfall, dense fogs, and continuous dews, and to inform the central authorities immediately of the appearance of a white efflorescence on the vines.

The central Phytopathological Station issued preliminary instructions for preventive treatment as soon as the information received indicated that the conditions were favourable for the germination of the winter spores and the first infection of the vines. Thereafter instructions were issued to vine-growers from time to time, in accordance with the reports of rainfall and other meteorological conditions supplied by the local observatories, regarding the appropriate treatment for every phase of the attack. These announcements were published in the provincial newspapers, at the Agricultural Colleges of the different centres, and by various agrarian committees, co-operative associations, and syndicates.

The relatively dry and mild winter of 1920–21 was followed by snowstorms in April which appreciably lowered the temperature and caused considerable physiological disturbances in growing plants, predisposing them to the attacks of parasites. The formation of zoospores from the winter spores began on 12th to 15th April, but not until 28th or 29th April did conditions admit of infection of the tissues of the vine. The first symptoms of attack became apparent on 16th to 17th May in the entire region under discussion, conidia being formed from 23rd to 25th May. During the last fortnight of May and almost the whole of June, conditions were favourable for the development of the disease, heavy dew and rain being followed by abnormally hot days. The virulence of the attack was most pronounced during the second half of June and the first ten days of July, especially on neglected vines. The persistent morning dews and the high humidity caused by evaporation at soil-level facilitated the continuous propagation of the parasite. The high temperature prevailing during the second part

of July and the whole of August prevented any further spread of the attack.

PETCH (T.). **Report on the work of the Division of Botany and Mycology.**—*Ann. Rept. Ceylon Dept. Agric.*, 1921, pp. 21-23, 1922.

Some of the diseases recorded in this Report have already been mentioned in the Quarterly Reports of the Botanist and Mycologist [see this *Review*, i, 5, p. 160; 10, p. 331]. The following are additional details:

RUBBER. The irregular rainfall during the south-west monsoon was unfavourable to leaf-fall and pod disease [*Phytophthora*], and there was no general outbreak. Root diseases were common, 43 per cent. of the specimens examined being due to *Fomes lignosus*, 41 per cent. to *F. lamaoensis*, 11 per cent. to *Ustulina zonata*, and 3 per cent. to *Poria hypobrunnea*.

TEA. Branch canker on young stems caused by *Macrophoma theicola* has been fairly prevalent. Like red rust [see this *Review*, i, 3, p. 92] it may be attributed to the cessation of manuring which was a consequence of the war.

COCO-NUTS. The Assistant Mycologist, Mr. C. H. Gadd, carried out experiments to determine the efficacy of Bordeaux mixture as a preventive of the parasitic form of nut-fall, but owing to the non-appearance of the causal organism (*Phytophthora* sp.) no apparent benefit was derived from the spraying. Of the total number of nuts removed from the palms during the year, 53·3 per cent. fell before reaching the age of two months, probably from natural causes; 44 per cent. were picked; and the remaining 2·7 per cent. fell before attaining maturity. A few cases of bud rot, one of great virulence, occurred during the year.

COFFEE. Die-back attributed to *Colletotrichum incarnatum* occurred on *C. robusta*. The teleutospores of *Hemileia vastatrix* were found throughout the year.

The diseases caused by species of *Phytophthora* in Ceylon are being investigated by Mr. Gadd, who found that a species isolated from papaw fruits [*Carica papaya*] was apparently identical with that attacking cacao and rubber 'pods', namely *P. faberi*. Cross inoculations showed that the strains from cacao and rubber would infect papaw fruits, though not so virulently as the papaw strain itself. The species of *Phytophthora* isolated from Nam Nam fruits (*Cynometra cauliflora*), which was at first believed to be identical with *P. meadii*, is now regarded as a distinct species. The fungus differs from *P. meadii* in its ready production of oospores in culture, and inoculation experiments on rubber pods gave negative results with it.

The species of *Pestalozzia* on tea, coco-nut, &c., are being investigated by Mr. Bertus, the results so far obtained indicating that the species on tea is not the same as that on coco-nut. *Mycosphaerella citrullina* was recorded on *Luffa acutangula*, *Cephaleuros minimus* on cacao twigs suffering from die-back; a species of *Cladosporium* caused a disease of *Setaria italica*, and a bacterial disease of cannas was observed.

VAN HALL (C. J. J.). **Ziekten en plagen der cultuurgewassen in Nederlandsch-Indie in 1921.** [Diseases and pests of cultivated plants in the Dutch East Indies during 1921.]—*Meded. Inst. voor Plantenziekten*, 53, 46 pp., 1921.

The meteorological conditions during 1921 were approximately normal, except for the excessive rainfall during the west monsoon in February and March, and during the east monsoon in October and December. The damage caused by fungi to the more important crops may be summarized under the following headings:

RICE. An extremely severe outbreak of root rot of rice was probably the aftermath of the abnormally rainy east monsoon of 1920. In Java and Madoera the loss of 'sawah' paddy in 1921 amounted to 12 per cent. of the entire area under rice. This estimate does not include partially damaged crops, so that the total figure would be at least half as much again. *Helminthosporium oryzae* occurred sporadically on the west coast of Sumatra.

RUBBER. No new diseases were reported during the year. On the east coast of Sumatra brown bast, stripe canker (*Phytophthora*), and root diseases (*Poria* and *Fomes*) were the commonest diseases and were everywhere under treatment by recognized methods. *Hypochnus* was also very widespread. The general experience seems to point to a considerable decrease of brown bast throughout the E. Indies as the result of the alternate day tapping system. Pink disease (*Corticium salmonicolor*) and canker occurred sporadically in certain localities, and were principally due to the neglect of proper precautions. In Central Java there was one severe outbreak of mouldy rot [*Sphaeronema* sp.], while another estate suffered considerable losses from a die-back of the tops of young trees. Mildew [*Oidium* sp.] was fairly prevalent in many districts, and on the east coast of Sumatra some of the defoliated trees failed to form new leaves in the rainy season. The Director of the Besoeki Experiment Station reported a severe case of infection by *Fomes pseudoferreus* (*Poria hypolateritia*). A few instances of 'kringrot', a peeling off of the outermost bast layer, occurred on the east coast of Sumatra.

POTATOES were severely attacked by leaf roll in the Tengger district of Pasoeroean, where the disease seems to be on the increase. Sprain also occurred in the Tengger district, and in the Residency of Tapanoeli. Scab was recorded from the Poedjonsche district of Pasoeroean. Slime disease (*Bact. solanacearum*) was of frequent occurrence on the 'kentang betawi' variety on the west coast of Sumatra, while the more or less sweet 'sawah' potato was immune. Dry rot was reported from the province of Preanger.

SUGAR-CANE in Java was severely attacked during the early part of the year by pineapple disease (*Thielaviopsis ethaceticus*). Red rot [*Colletotrichum falcatum*] occurred on one estate, and root rot was reported from all parts, especially in the variety EK 28. The yellow stripe [mosaic] and sereh diseases were not of much importance. Gummosis occurred sporadically all over Java, but in most cases the attacks were very mild.

TOBACCO. At the Deli Experiment Station extremely virulent outbreaks occurred of *Phytophthora nicotianae* and slime disease (*Bact. solanacearum*), especially the latter which was prevalent

both in the seed-beds and in the field. Both these diseases were recorded from other localities, but not to the same extent. Considerable damage was done by *Phytophthora* to the stalks of tobacco plants in the field at the Besoeki Experiment Station. Black rust (*Bacillus pseudozoogloeae*) occurred at Deli. Mildew [*Oidium* sp.] was again very prevalent at the Vorstenland Experiment Station, its extremely rapid spread being particularly noticeable. Mosaic disease was reported from the Besoeki Experiment Station, the shoots of topped plants being particularly liable. Two abnormal conditions, 'krepoh' [leaf curl] and 'kroepoek', which are not described, also caused considerable losses.

TEA. Mild attacks of *Pestalozzia, Laestadia, Hypochnus theae, Corticium javanicum, Capnodium, Thyridaria tarda*, &c., were recorded from the tea plantations of Java and Sumatra. The damage caused by red rust (*Cephaleuros virescens*), the most formidable vegetable parasite of tea in Java, was in some districts considerable. Root diseases caused by various fungi (*Rosellinia, Armillaria, Ustulina zonata*) are found in gardens at high elevations, and the root disease problem is a serious one on the east coast of Sumatra.

COCO-NUT. *Pestalozzia* was prevalent in one or two districts, and a leaf disease, the cause of which is not specified, was recorded from the province of Menado.

COFFEE. The incidence of the cobweb disease (*Hypochnus*) was higher than in previous years. Mottling of the leaves of young Robusta coffee trees occurred on a large scale in one estate. Pink disease (*Corticium salmonicolor*) and brown root disease [*Fomes lamaoensis*] were also reported, the latter being common on freshly cleared land.

MAIZE. Downy mildew (*Sclerospora javanica*) was prevalent in most districts, but only in a few instances were the losses heavy. In the province of Pasoeroean the late planted 'sawah' maize was severely attacked by this disease.

OIL PALM. The crown or 'juvenile' disease [see this *Review*, i, 1, p. 20] was again very prevalent. The disease never ends fatally, but the development of the trees is arrested, and they remain in a backward condition. It has now been ascertained that trees above five years old are also liable to attack, so that the term 'juvenile' is scarcely applicable. The cause of the disease is not known, but a physiological origin is indicated. A case of bud rot was reported from Besoeki.

GROUND-NUT (*Arachis hypogaea*) was severely attacked by slime disease (*Bact. solanacearum*) in all districts. In one case the loss amounted to 15 per cent. Leaf curl occurred in the Kediri province, and is attributed by the natives to a sudden rainy period following a prolonged drought.

CINNAMON (*Cinnamomum burmanni*) was attacked by bark or stripe canker (*Phytophthora cinnamomi* Rands) at an experiment station on the west coast of Sumatra.

CINCHONA. Pink disease (*Corticium salmonicolor*) occurred on young 'Ledger' seedlings after an attack of *Helopeltis*, as well as on older plants. Cinchona roots are liable to attack both by *Armillaria* and by a species of *Rosellinia*, and the mycelia of these

fungi are frequently visible on the diseased parts. There are many cases of root disease, however, in which the most striking symptom is the decay of the cortex. Pressure on the damaged tissue causes moisture to exude, and the diseased parts emit a foul smell. The cause appears to be unknown. Stem rust and canker continue to occur, while 'mopog' (*Moniliopsis aderholdi*) is reported from various estates.

Amongst the diseases recorded on various minor crops were leaf curl on *Phaseolus mungo* and *Vigna sinensis*, and *Bact. solanacearum* on soy-beans.

Departmental Activities: Botany.—*Journ. Dept. Agric. S. Africa*, iv, 4, p. 306, 1922.

Downy mildew, due to *Sclerospora graminicola*, has occurred for the last two seasons on Sudan grass (*Sorghum sudanense*). The crop in a field which became affected with the disease after the second cutting had a scorched appearance, and the leaves were marked with long, narrow, at first yellow or reddish, and finally dark brown, streaks or patches, covered with a fine, white down consisting of the conidia of the fungus. The affected areas appear to spread from the lower to the upper leaves and from the apex to the base of individual leaves. In other countries, especially in India, *S. graminicola* occurs on several important cereals, and while at present the disease is not a serious one in South Africa, it may, under suitable conditions, become very troublesome, and it should therefore be kept under close observation.

Regulations to prevent the introduction of potato wart disease (*Synchytrium endobioticum*) with imported seed have been in force in South Africa for the last ten years, but it now appears that the disease had been introduced in certain areas before they were applied. Its occurrence in the Impendhle Division, Natal, has recently been reported, while a similar report from the Queenstown-Cathcart area awaits confirmation.

Smith (E. F.). **Fasciation and prolepsis due to crown gall.**—*Phytopath.*, xii, 6, pp. 265–269, 5 pl., 1922.

The author has succeeded in demonstrating that fasciation can be produced experimentally by inoculating the crown gall organism (*Bacterium tumefaciens*) into the leaf axils of *Nicotiana*, *Pelargonium*, *Ricinus*, *Brassica*, and *Tropaeolum*, and suggests that many other fasciations may be due to the penetration of foreign organisms into the growing point.

In the striking case which is fully illustrated by photographs, a young nasturtium plant was inoculated through needle pricks in a leaf axil. The fasciated shoot (shown as it appeared a month later) was the only axillary shoot that developed. It arose from a dormant bud along with the growth of the tumour resulting from the inoculation. This was the only successful case out of fifteen nasturtiums inoculated; apparently the needle must enter the actual dormant bud, which is not always easy to attain. In the rest, the shoot which usually developed from the inoculated axil (none of the other axils gave shoots) was not fasciated. It was, however, abnormally vigorous in growth in several cases, and rapidly gave

rise to secondary, tertiary, and even quaternary shoots within a period of two months, from buds that under normal circumstances would have remained dormant. This forced growth is compared with that which occurs in peach yellows, and is explained on the supposition that the growth of the tumour at the base of the shoot stimulates the movement of water and nutrients in this direction. Continual growth of the tumour, however, effects an invasion and compression of the vascular tissues at the base of the shoot, with the result that the latter wilts. At an early stage of this compression, the downward movement of elaborated foodstuffs from the axillary shoot would very likely be interfered with sufficiently to act as a further stimulus to its growth. Tests for starch showed a marked accumulation in the cortex, pith, and medullary rays of these shoots, as would be expected if the downward flow of elaborated nutrients were checked. It is suggested that the proximate cause of the forced growth in peach yellows must be the same, namely the stimulus of excessive amounts of water and foodstuffs acting locally as the result of phloem injury.

BENOIST (J.) & BAILLY (P.). **Moyens de combattre le piétin des céréales.** [Control measures against foot rot of cereals.]—*La Vie agricole*, xi, 40, pp. 266–268, 1 fig., 1922.

The authors report that their previous investigations indicated that one crop of wheat immediately succeeding another is seldom attacked by foot rot (*Ophiobolus graminis* [*O. cariceti*] and *Leptosphaeria herpotrichoides*), whereas infection almost always occurs on soil which carried wheat two years previously. The longer period between crops appears in some way to favour the disease.

Experiments in the control of the disease were carried out on autumn wheat of the Geffroy variety, the trial crop, sown on 8th November, 1921, having been preceded by wheat. An application of stable manure, which is stated to promote the development of foot rot, was given, together with 400 kg. per hectare of superphosphate. The field was divided into six plots, which were treated as follows: (1) control; (2) sprinkling of the stubble, before ploughing, with a 4 per cent. solution of iron sulphate; (3) 400 kg. per hectare of iron sulphate mixed with the soil by ploughing; (4) sprinkling on 9th March, 1922, with a 4 per cent. solution of iron sulphate: (5) sprinkling on the same date with a solution of sulphuric acid; (6) 600 kg. per hectare of chloride of potassium spread in January.

The control plot was slightly attacked by foot rot, but owing to the drought, and to the fact that wheat immediately succeeded wheat, the damage was not severe. The percentage of infection was considerably reduced both by sprinkling the stubble with iron sulphate, and by mixing this in at ploughing time. Very slightly less favourable results followed sprinkling with iron sulphate in the spring. Excellent effects were produced by spreading chloride of potassium and by sprinkling with sulphuric acid. It is uncertain whether the marked reduction of infection in the two latter cases was due to the caustic action of the minerals or to their fertilizing powers.

SMITH (C. O.). **Pathogenicity of the Olive knot organism on hosts related to the Olive.** *Phytopath.*, xii, 6, pp. 271–278, 2 pl., 1922.

The pathogenicity of *Pseudomonas savastanoi* E. F. Smith on the olive has been fully determined, but hitherto negative results were obtained in the various attempts to inoculate plants more or less closely allied to the olive.

The present paper deals with inoculation experiments extending from 1919 to 1921, and carried out on the olive (*Olea europea*), *Fraxinus velutina*, *F. floribunda*, *Adelia acuminata*, *Ligustrum ovalifolium*, *Chionanthus virginica*, *Osmanthus fragrans*, *Osmanthus aquifolium*, *Vinca*, *Thevetia nereifolia*, *Nerium oleander*, *Coprosma baueri*, *Carissa grandiflora*, *Chrysanthemum frutescens*, *Elaeagnus angustifolia*, lilac, jasmine, and several species of *Prunus*. Typical artificial knots were produced only on *Adelia*, both species of *Fraxinus*, and jasmine. Definite lesions were produced on *Osmanthus aquifolium* and *Chionanthus*, and small knob-like growths developed on *Ligustrum* in one series of tests. The galls produced on *Adelia*, *Fraxinus*, and jasmine were smaller than those on the olive, with the possible exception of some on *F. floribunda*. They appear to reach their maximum size in three or four months, after which the tissue gradually dies. In the olive this process is of longer duration.

Infection seems to be restricted to plants allied botanically to the olive, especially those of the family Oleaceae. The olive knot organism is characterized by the production of masses of bacteria in definite cavities within the hypertrophied tissue of the olive. It differs herein from the galls of *Bacterium tumefaciens* on various hosts, where very few organisms are present in the hypertrophied cells. *Ps. savastanoi* is further differentiated from *Bact. tumefaciens* by its limited pathogenicity.

MACINNES (JEAN). **The growth of the Wheat scab organism in relation to hydrogen-ion concentration.**—*Phytopath.*, xii, 6, pp. 290–294, 1 fig., 1922.

A strain of *Fusarium* isolated from scabby wheat in Minnesota was found to be capable of growing in nutrient media ranging from P_H 3·0 to P_H 11·7. This exceptionally wide range of tolerance is compared with the published figures for a number of other pathogenic organisms, the authority in each case being given. The *Fusarium* strain in question has been found to be capable of attacking a very large number of hosts, and further work with it will be published elsewhere.

KULKARNI (G. S.). **Conditions influencing the distribution of grain smut (Sphacelotheca sorghi) of Jowar (Sorghum) in India.**—*Agric. Journ. India*, xxvii, 2, pp. 159–162, 1922.

In a previous publication (*Pusa Bull.* 78, p. 13) the author suggested, on the evidence obtained from germination studies of the spores of *Sphacelotheca sorghi*, that temperature had an important bearing on the distribution of the disease. Sorghum is usually sown in India in June–July, with an average temperature of 21° to 30° C., which is favourable for the germination of the smut spores.

but below the optimum for the germination of the grain. In certain areas, however, e.g. the Indo-Gangetic plain, the temperature at sowing time is 30° to 40° C., which is too high for the spores to germinate, but favourable for the germination and rapid growth of sorghum; the disease in these regions is scarce. In pot experiments carried out at the Mycological Laboratory at Poona, pots sown with infected sorghum and incubated at 40° C. for three days showed no infection of the seedlings, while in other pots incubated at 25° C. the amount of infection varied from 50 to 60 per cent. This clearly shows that temperature is a limiting factor to infection by this smut. A confirmation of this conclusion was also supplied by field experiments carried out by sowing seed mixed with spores in 1918 and 1920 at Pusa, and at the Government farms at Larkhana and Jacobabad in Sind, similar sowings at Poona serving as a control. The results, full details of which are given, were particularly definite at Jacobabad in 1920, where, with a temperature of 36° to 40° C. at sowing time, there was no smut, against 65 per cent. at Poona where the temperature was only 25° C.

HURSH (C. R.). **The relation of temperature and hydrogen-ion concentration to urediniospore germination of biologic forms of stem rust of Wheat.**—*Phytopath.*, xii, 8, pp. 353–361, 7 figs., 1922.

Two biologic forms of *Puccinia graminis* of wheat, collected in California and France respectively, and differing in their parasitic behaviour, showed considerable differences in germination response to temperature and hydrogen-ion concentration when uredospores of the same age, grown under similar greenhouse conditions on Little Club Wheat (which is susceptible to both forms), were used. Temperatures of 10°, 20°, and 30° C. were used, and a P_H range of from 2·5 to 8·0. The form more limited in its host range (that sent from France) was also more restricted in tolerance of extremes of hydrogen-ion concentration and temperature. The differentiation of biologic forms is not entirely dependent on their parasitic behaviour on certain plants. At least some biologic forms apparently possess individual physiological characteristics demonstrable by physical and chemical means. The possession of such characteristics alone may be sufficient to establish them as definite taxonomic entities.

HUNGERFORD (C. W.). **The relation of soil moisture and soil temperature to bunt infection in Wheat.**—*Phytopath.*, xii, 7, pp. 337–352, 5 figs., 1922.

The infection of the soil with wind-blown spores of *Tilletia tritici* has been known for a number of years to result in smutted crops in the Pacific North-West region of the United States. This infestation does serious damage, and renders control very difficult.

Soil temperature and soil moisture have been proved in recent years to be important factors in infection by fungi. Observations made at Idaho have shown that, on contaminated soils, the amount of soil moisture at planting time may have a very marked effect on the amount of bunt in the resulting wheat crop. Experiments were carried out to determine this relationship more exactly.

Wheat was grown at Moscow, Idaho, in six containers filled with bunt-contaminated soil, varying in moisture content from 8 to 32 per cent. at the time of planting, and with a 'moisture equivalent' of 27·2 [cf. Briggs and McLane, *Proc. Amer. Soc. Agron.*, ii, p. 138, 1911]. The percentage of bunt increased progressively to 100 per cent. infection as the percentage of soil moisture increased. A repeat experiment at Nez Perce, Idaho, gave similar results.

Greenhouse experiments in which both moisture and temperature were controlled showed that low soil temperature (9° to 12° C.) and a fairly high percentage of moisture in the soil (about 22 per cent. with a moisture equivalent of 20·7) are both favourable to infection. An exceedingly high percentage of moisture, however, seemed to inhibit infection. A small amount of infection took place even when the temperature was as high as 25° to 28° C.

Preliminary experiments appear to indicate that bunt spores lose their power to infect rather rapidly, since not more than 4½ per cent. infection resulted from artificially infected soil sown after the lapse of a month.

PELTIER (G. L.). **A study of the environmental conditions influencing the development of stem rust in the absence of an alternate host. I. The viability of the urediniospores of Puccinia graminis tritici Form III.**—*Agric. Exper. Stat. Nebraska, Res. Bull.* 22, 15 pp., 3 figs., 1922.

In order to determine with accuracy the viability of the uredospores of stem rust of wheat under controlled conditions, the author subjected uredosori of approximately the same age on detached wheat seedling leaves to various combinations of constant temperatures and relative humidities. Ordinary bacteriological incubators were employed for temperatures of 25° and 30° C., while for lower temperatures a special apparatus [which is described in detail] was devised. Constant relative humidity was maintained in each chamber by means of sulphuric acid solutions. The experiments extended over a period of sixteen weeks.

The method of procedure was as follows: Some 2,000 Little Club Wheat seedlings were inoculated with two weeks old material of *Puccinia graminis tritici* Form III from a stock culture supplied by Stakman, in a greenhouse free from other rusts, a composite inoculum being obtained by shaking the spores from the sori on to a glass plate. The inoculated plants were incubated at a constant temperature of 25° C. for forty-eight hours, after which they were placed in a controlled-temperature greenhouse for twelve days at a mean temperature of 24° C. The infected leaves were then cut off and some thirty leaves were placed in each moist chamber. The moist chambers were in sets of 11, each set forming a series of from 0 to 100 per cent. relative humidity at approximately 10 per cent. intervals. One such set was placed in each temperature chamber, the temperatures used being 5°, 10°, 15°, 20°, 25°, and 30° C. No germination of the uredospores occurred at 30° C., while at 25° C. germination took place only at the medium relative humidities. The maximum duration of viability (five weeks) at this temperature occurred at the relative humidity of 49·0 per cent. At 20° C. the spores were viable for one week at 100 per cent.

relative humidity, and for eleven weeks at 49·0 per cent.; with each succeeding drop in the relative humidity below 49·0 there was a decrease in the percentage of germination and the duration of viability. At 15° C. the uredospores were viable for longer periods at all humidities than at 20° C., but the duration of viability was again longest at relative humidities of 49·0 to 60·7 per cent. (ten weeks). At 10° C. the spores gave a higher percentage of germination, and were viable for longer periods at nearly all humidities than at 15° C.; fairly high percentages of germination occurred at the end of the sixteenth week at the relative humidities of 38·0, 49·0, and 70·4 per cent. At 5° C. the viability of the spores at the medium humidities was still fairly high at the conclusion of the experiment, but at relative humidities below 38·0 per cent. the spores were not viable for such long periods as at 10° C. Somewhat peculiar results were obtained at the relative humidity of 10·5 per cent. at all temperatures below 25° C., a lower percentage of germination occurring at this point than at the relative humidities of 0 and 21·5 per cent.

The results of infection tests corresponded as a rule with those of the germination trials. Few or no infections were obtained with any inoculum showing less than 10 per cent. of germination. As the percentage of germination decreased from week to week, the germ-tubes became shorter and narrower, and their protoplasm less dense. The use of such a comparatively weak inoculum resulted in the production of hypersensitive flecks on the leaves, indicating that, while the spores were capable of germination and of penetrating the tissues, the resistance offered by the host cells was greater than the fungus could overcome.

The writer's field experiments at Lincoln support the general consensus of opinion on the viability of the uredospores of stem rust, namely that the latter do not overwinter in the North. Rust epidemics were started in the autumn and the uredospores germinated readily until January, but not later. The results of the experiments reported above show that down to certain temperatures the uredospores are viable for long periods at the prevailing relative humidities encountered in the field during the autumn in the winter wheat belt. It is further clearly demonstrated that at constant temperatures somewhat below the average prevailing during the summer in the South, the uredospores are not viable for any length of time at any relative humidity. The mortality of the free uredospores, extremely high at all times, is greatly increased by the absence of suitable conditions for infection. It therefore seems safe to assume, in view of the brief duration of such conditions, that only a small proportion of the countless number of spores produced actually infect the host.

STONE (R. E.). **Leaf scorch or mollisiose of the Strawberry.**—*Phytopath.*, xii, 8, p. 375–380, 3 figs., 1922.

Leaf scorch or mollisiose is very prevalent in parts of Ontario and the United States. The first symptoms in new attacks appear on the leaves in May in the form of irregular purple blotches, $\frac{1}{8}$ to $\frac{1}{4}$ in. in diameter. Purple stripes may be present on the petioles and flower peduncles. The blotches gradually turn grey and

coalesce, and in time the whole leaf may be involved. By July or August the beds frequently present a scorched appearance. The following spring the disease appears early. The diseased plants do not winter well, and the crop may be very short the second year.

Varietal susceptibility is very marked. The most susceptible varieties appear to be Clyde, Glen Mary, Doctor Burrill, and Pokomoke, the remaining common varieties being moderately or slightly susceptible.

An examination of the older portions of leaf blotches and diseased petioles reveals the presence of dark acervuli filled with hyaline bicellular spores belonging to the fungus *Marssonia potentillae* (Desm.) Fischer. The fungus overwinters in the leaves and produces conidia in the spring. An ascigerous stage, agreeing with descriptions and specimens of *Mollisia earliana* (E. & E.) Sacc., may be found on the more exposed leaves from late April to June. The conidia of *M. potentillae* are often present on the leaves, simultaneously with the ascocarps of *M. earliana*, and cultures from single ascospores have given the *Marssonia* stage.

Full descriptions of both the stages are given and also their synonymy. Inoculations with pure cultures bearing conidia were successful.

The disease can probably be controlled by the measures applicable to leaf spot (*Mycosphaerella fragariae*).

HEMMI (T.). **On the occurrence of Mycosphaerella wilt of Musk-melons in Japan.**—*Phytopath.*, xii, 8, pp. 394–397, 1922.

The presence of *Mycosphaerella citrullina* in both the perithecial and pycnidial stages is recorded on diseased musk-melons in Japan. The symptoms of the disease and characters of the fungus agree with those previously described in America. The pycnospores are hyaline and mostly bicellular, but may be continuous or with two or three septa. The writer was recently informed that the fungus had also been found on the leaves and vines of a species of gourd (*Lagenaria vulgaris* var. *gourda*) in the Shizuoka Prefecture.

SKUBEZ (V.). **Plötzliches Absterben der Obstbäume.** [Sudden death of fruit trees.]—*Allg. Weinzeit.*, xxxix, 34, pp. 133-134, 1922.

During the spring of 1922 great numbers of young fruit trees, chiefly apples, in all the fruit-growing districts of Carinthia [Tyrol] were suddenly killed off just when beginning to bloom. To the naked eye there were no signs of disease or mechanical injury on the trees. The phenomenon was assumed to be connected with the abrupt alternations of temperature between the abnormally hot summer of 1921 and the severe winter of 1921–22. Specimens of the affected material have been examined, and although the final results of the investigation will not be announced until later, a preliminary report is already available.

The typical symptoms of frost injury could not be detected either in the wood or cortex. Occasional brownish discolorations were observed in the phellogen and in that part of the conducting cells of the phloem bordering on the cambium, where the cell-walls were also swollen at intervals. These symptoms, however, were not

present in all the branches. The cambium was usually dead, the formation of wood having ceased from the previous autumn with the exception of a few, isolated, spring wood cells. The pith was discoloured only in places.

These investigations, together with the meteorological conditions referred to above, suggest the following conclusions. The trees were suffering in the first instance from the abnormal drought of the summer of 1921, which principally affected the tissues of the cambium. This water-shortage was intensified by the excessively low temperatures of the following winter, which extended into the soil to a depth of one metre. As the result of the protracted plasmolysis of the living cells thus brought about, the latter were unable to meet the demands of the newly-circulating sap in the spring and the development of shoots and blossoms stopped abruptly. Hence the sudden death of the trees was only indirectly due to the cold, the proximate cause being the exhaustion of the water-supply.

RANKIN (W. H.) & HOCKEY (J. F.). **Mosaic and leaf curl (yellows) of the cultivated red Raspberry.**—*Phytopath.*, xii, 6, pp. 253–264, 1922.

This is a more detailed account of the author's investigations referred to in a previous abstract [see this *Review*, i, 7, p. 218]. One or other of the two diseases is stated to be probably present in all the larger small-fruit districts of the northern United States and Canada. The 'running-out' of varieties, especially the Marlboro and Cuthbert, and the marked decline in acreage in many districts have been attributed to them.

The leaf curl has many points of similarity to potato leaf roll, and raspberry plants affected with this disease show a necrosis of certain elements of the phloem and pericycle resembling potato phloem-necrosis.

A list of thirty red and purple varieties of raspberry which have been observed affected with mosaic is given. An outwardly similar disease is also common on some cultivated varieties of black raspberries. Leaf curl has been seen on the wild *Rubus strigosus*, the ornamental *R. phoenicolasius*, and an unknown variety of black raspberry.

GIROLA (C. D.). **Ganoderma sessile Murrill.**—*Bol. Minis. Agric. Nación (Buenos Aires)*, pp. 236–239, 2 pl., 1922.

Considerable damage is caused to various fruit and forest trees in the Argentine by *Ganoderma sessile* Murrill, which has been found in one plantation on *Prunus armeniaca*, *P. domestica*, *Pyrus communis*, *Ficus carica*, *Punica granatum*, *Robinia pseud-acacia*, *Gourliea decorticans*, *Casuarina stricta*, *Eucalyptus globulus*, *Tipuana tipa*, &c. Infection is caused either by the mycelium, which spreads from diseased to healthy roots, or by spores falling on to wounds or lesions on the exposed roots or base of the trunk.

Severely attacked trees, and all sporophores, should be removed and burnt. In limited attacks the affected parts should be excised and the wound disinfected. In new plantations the application of manure should be avoided, and care must be taken not to wound the young plants. In suspicious cases the roots may be treated

before planting with formalin or with 1 in 1,000 corrosive sublimate. Stakes for young trees should be disinfected with copper sulphate, formalin, or hot tar. A period of three years should be allowed to elapse before replanting in infected soil. Humidity promotes the development of the fungus, and care should therefore be taken to drain the water from the collars of the trees.

CSEFE (A.). **Die Wirkungen von Uspulun, Formalin, Kupfervitriol, Schwefelkalkbrühe und Klorol auf die Keimfähigkeit des Zuckerrübensamens.** [The action of uspulun, formalin, copper sulphate, lime-sulphur, and klorol on the germination of the seed of Sugar Beet.]—*Kisérletügyi Közlemények*, xxiv, 1921. [Abs. in *Zentralbl. für Agrikulturchemie*, li, 8, p. 207, 1922.]

The vitality and germinative power of the seed of sugar beet are increased by the use of uspulun, copper sulphate, klorol, formalin, and lime-sulphur, in the order given. These preparations are recorded as being of practical and scientific value, not only on account of their fungicidal properties, but also because of the stimulus which they afford to germination.

BUTLER (O.) & SMITH (T. O.). **On the use of acetates of copper as fungicides.**—*Phytopath.*, xii, 6, pp. 280–289, 1 fig., 1922.

Two acetates of copper are used as fungicides, the normal or neutral acetate of copper $Cu(C_2H_3O_2)_2.H_2O$, and the basic acetate of copper $Cu(C_2H_3O_2)CuO.6H_2O$, the former containing 31·8 per cent. of metallic copper and the latter 34·4 per cent. There is ample evidence that the acetates of copper compare favourably with Bordeaux mixture in fungicidal properties. Both the acetates ('verdets') have been used by vine-growers for the last thirty years in the south of France and Italy, with excellent results, but in America they are very little known. The acetates of copper are non-toxic to the plants on which they are used, and form less conspicuous spots than the cuprammoniums (ammoniacal copper compounds).

The adhesiveness of the acetates of copper depends on the degree of decomposition which takes place during drying, and on the length of time elapsing between application and the first washing rain. Basic acetate is more adhesive than neutral acetate, and decomposes more rapidly on exposure to air. Neutral acetate, however, is more easily obtainable than basic acetate, and its adhesiveness can be greatly increased at a small cost by the addition of 0·05 per cent. of gelatine. At the end of forty-eight hours the adhesiveness of neutral acetate plus gelatine is virtually equal to that of basic acetate alone, and at subsequent periods it is only slightly lower. The same proportion of gelatine added to basic acetate also produces an increase of adhesiveness chiefly during the first day of drying, i.e. the time when the maximum of adhesiveness is required.

The writers propose the following formulae, using a stock solution of the acetate made by dissolving the substance in cold water at the rate of 1 lb. per gall. Formula 1 : water 49 galls., basic acetate of copper (stock solution) 1 gall. (or for a stronger solution 46 : 4). Formula 2 : water 48 galls., basic acetate or neutral acetate (stock

solution) 1 gall., gelatine (stock solution) 1 gall. (or for a stronger solution 45 : 4 : 1). The stock solution of gelatine is made by dissolving 4 oz. of gelatine in 5 quarts of hot water, and should not be above 40° C. when added to the acetate. The weaker strengths given above are intended for use in place of a cuprammonium spray, the stronger where a colourless fungicide is required in place of Bordeaux mixture and of the same fungicidal value.

HENNING (E.). **Om betning mot Stinkbrand (Tilletia tritici), Strå-brand (Urocystis occulta), och Hårdbrand (Ustilago hordei). II. Bidrag till formalinbetningens teknik.** [Disinfection against bunt (*Tilletia tritici*), flag smut (*Urocystis occulta*), and covered smut (*Ustilago hordei*). II. Contribution to the technique of disinfection with formalin.]—*Meddel. Centralanst. för försöksväsendet på jordbruksområdet*, 231, 36 pp., 3 figs., 1922.

The preparations in general use in Sweden for the control of bunt and other smuts are copper sulphate, uspulun, and formalin. The two first named have various drawbacks. Both are poisonous, and the residue of the treated seed therefore cannot be used for feeding. The application of copper sulphate is tedious and complicated, and its danger to seed damaged by threshing is not entirely removed by the addition of milk of lime. The poisonous constituents of the mercury chlorophenol contained in uspulun still adhere to the seed even if the latter is washed after treatment. A further disadvantage of uspulun is that the effective principle is absorbed by the seed at a quicker rate than the water, so that a certain quantity of the fungicide has to be added to maintain the proper concentration during repeated use.

The author has conducted numerous experiments with a view to modifying the technique of formalin disinfection, the one objection to which is the reduction of germinative power during storage. The results showed that washing the seed in water after treatment with formaldehyde at various concentrations lessened this injury. Ordinary rinsing is usually sufficient, but if a very high concentration of formaldehyde is used, or if the varieties are particularly susceptible to injury, then the seed should be immersed in water. Further tests showed that seed rinsed after treatment and dried in a cellar germinated to the extent of 87·7 per cent. even when kept for eleven months before sowing. The results of comparative tests with germisan, formaldehyde, and hot water showed no appreciable difference between the two former methods. Germisan has the disadvantage of being extremely poisonous. The percentage of seed which germinated after treatment with hot water was slightly below the other two methods and the control.

Formalin is comparatively inexpensive, the quantity of diluted solution required (80 litres) for the disinfection of 100 kg. of grain costing only Kr. 1.20 [about 1*s.* 5*d.*]. When the treatment is carried out with 100 kg. lots, each further 100 kg. of grain requires only 10 litres of the solution to replace what has been used. Formalin does not lose its strength after repeated use. Immersion is a far more reliable method of disinfection than sprinkling.

The concentrations recommended are 0·15 per cent. formaldehyde for rye and wheat, and 0·2 per cent. for barley and oats. The

temperature of the solution should not be less than 12° to 15° C. The grain should be poured slowly into the solution (which should stand 10 cm. above the grain) and stirred with a blunt wooden shovel. The subsequent washing in water is carried out as follows: Three barrels are used, one raised above the others. The steeping takes place in the raised barrel (*a*) which is furnished with a tap. After twenty minutes the solution is drawn off into the left-hand lower barrel (*b*), (*a*) being filled with water for rinsing. After five to ten minutes the rinsing water is drawn off into the right-hand lower barrel (*c*). The solution in (*b*) can then be poured back into (*a*) and used again. If the process is carried out in the open the third barrel is superfluous, the water simply being run off on to the ground. Treated in this way the grain may be kept for a week or more before sowing.

A comprehensive bibliography, containing seventy references, is appended.

KREUZPOINTER (J.). **Einiges über das Beizen der Samen.** [Notes on seed steeping.]—*Wegweiser im Obst- und Gartenbau*, v, 1922. [Abs. in *Zentralbl. für Agrikulturchemie*, li, 8, p. 208, 1922.]

Uspulun used as a seed steep on old seed of celery and mangolds stimulated germination while a steep of corrosive sublimate retarded it. Anthracnose of kidney beans [*Colletotrichum lindemuthianum*] was controlled, and the yield increased fivefold. Celery rust was also suppressed. In both cases, however, the treated crop later became infected from neighbouring diseased plants. The beds should therefore be isolated as far as possible.

WIELER (A.). **Die Beteiligung des Bodens an den durch Rauchsäuren hervorgerufenen Vegetationsschäden.** [The rôle of the soil in the injuries to vegetation produced by smoke acids.]—*Zeitschr. für Forst- und Jagdwesen*, liv, 9, pp. 534–543, 1922.

The prevailing opinion that the injuries caused to vegetation by the fumes of acid gases develop almost entirely in the leaves cannot be unreservedly accepted. The author's observations and investigations in the forests of Stolberg on the Rhine and Clausthal in the Harz Mountains, both of which have suffered severely from smoke injury, have convinced him that the removal of lime from the soil by acid gases is primarily responsible for the protracted enfeeblement and final death of the trees. Experiments showed that the withdrawal of lime from the soil caused the formation of bare patches, on which even the common weeds of the district would not grow. After the application of lime to the affected patches, however, it was possible to grow broad-leaved trees and conifers. It has also been shown by comparative investigations that the withdrawal of lime takes place on a more extensive scale immediately under trees suffering from smoke injury. The absence of grass under trees in the parks and suburbs of manufacturing towns is due, not to the shade cast by the branches, but to a deficiency of lime in the soil under them. In the coal-mining districts of Westphalia the author noticed large bare patches in fields, the site of

which was formerly occupied by woods. The application of lime removed all trace of these bare patches.

The root system is the first part of the plant to suffer from the deficiency of lime, but the effects are rapidly communicated to the aerial organs. Removal of lime also produces important modifications in the physical and biological composition of the soil, which react on the development of the trees.

These and other investigations show that, in forests especially, the influence of the acid gases on the soil, quite apart from any direct action on the leaves, must be taken into consideration. In cases of general debility, with no definite external symptoms, soil disturbances may reasonably be suspected, while they are frequently, as stated above, correlated with damage to the leaves.

Smoke injury may be combated to some extent by liming, but in severe cases it may be necessary to convert the forests into pasture and arable land, which are very much less susceptible than trees to the action of the fumes.

LANGERON (M.). **Un nouveau Sporotrichum malgache : Sporotrichum carougeaui Langeron, 1913, et remarques sur les Sporotrichés.** [A new Madagascar *Sporotrichum* : *Sporotrichum carougeaui* Langeron, 1913, and observations on the *Sporotricha*.]—*Bull. Soc. Path. exot.*, xv, 6, pp. 453–459, 2 figs., 1922.

After a brief discussion of the characters and systematic position of the genus *Sporotrichum*, the author describes in detail a new pathogenic *Sporotrichum* discovered in 1910 in Madagascar by Fontoynont and Carougeau. The fungus, which was isolated from ulcers on the neck and armpit of a native child, differs macroscopically from other species of *Sporotrichum* by its dazzling white colour which persists in the oldest cultures. The hyphae are septate, creeping, and 2·5 to 4 μ in diameter. The conidia are at first elliptical, and measure 2 by 4 μ, afterwards becoming circular, and attaining a diameter of 4 to 5 μ. They are produced at irregular intervals, along the whole length of the hyphae, either singly or in clusters, and may elongate and give rise, by a budding process, to secondary conidia.

The cultures of *S. carougeaui* exhibited a remarkable morphological uniformity, with no tendency to the production of *Botrytis*, *Graphium*, or other forms such as Boulanger and Vuillemin observed in cultures of *Sporotrichum* and *Rhinocladium*. Yeast forms were produced in abundance in cultures under certain conditions not yet determined. Probably this is the form in which the fungus exists in the tissues.

ELMER (O. H.). **Mosaic cross-inoculation and insect transmission studies.**—*Science*, N. S., lvi, pp. 370–372, 1922.

It is generally believed that the mosaic diseases of the Cucurbitaceae, Solanaceae, and Leguminosae are transmissible, with few exceptions, only to species within the same family. Cross-inoculation experiments by the writer have shown, however, that these three diseases are inter-transmissible.

Four petunia plants inoculated by inserting pieces of tissue with

mosaic from crookneck squash into wounds in the stem became infected, while an equal number of controls remained healthy. Hypodermic inoculation of four crookneck squash plants with juice from tomato mosaic and four with juice from tobacco mosaic resulted in infection in all cases. One tobacco and two tomato plants inoculated with juice from mosaic crookneck squash leaves also became infected. In another experiment the insertion of mosaic crookneck squash leaf tissue into the midribs of five tobacco plants resulted in complete infection. Only one of five tobacco plants similarly inoculated with mosaic cucumber tissue became infected. Three out of five tomato plants inoculated with mosaic from catnip (*Nepeta cataria*) became infected.

Experiments with the cow-pea (*Vigna catjang*), which is susceptible to mosaic under greenhouse conditions, showed that the disease is transmissible by aphids, full infection occurring on seedlings in insect proof cages into which aphids from mosaic plants were introduced, while all the controls remained healthy. Numerous experiments have also demonstrated that the mealy bug (*Dactylopus* sp.) transmits the disease, especially in the case of cow-peas and soy-beans. When mealy bugs from a mosaic crookneck squash plant were transferred to 33 cow-pea seedlings they gave 100 per cent. of infection. Identical results were obtained in the case of 38 cow-pea seedlings inoculated by means of mealy bugs from mosaic infected eggplant. The transference of aphids from mosaic potato to 36 cow-pea seedlings resulted in the infection of 28. Mealy bugs were transferred from mosaic infected cow-pea to soy-bean seedlings, a large percentage of which developed the disease. In all the above experiments the controls remained healthy. The tobacco plants and one tomato were also infected with mosaic from crookneck squash through the agency of *Dactylopus* sp.

The writer is of opinion that mosaic infection is largely determined by the growth condition of the plant, unchecked, vigorous development promoting infection. Successful cross-infections between members of different families are more readily obtained with plants growing under favourable conditions than with those less well situated.

NARASIMHAN (M. J.). **The Areca koleroga work during 1921.**—*Mysore Agric. Calendar*, pp. 4–8, 1922.

The year under consideration was marked in Mysore by a recrudescence of the koleroga disease of areca palms [*Phytophthora arecae*] due to the heavy rainfall during the later part of the season. In five districts the number of trees sprayed against the disease amounted to about 372,000, covering a total area of over 900 acres as against 300 acres treated during the previous year. A fairly successful attempt was made to induce all the owners of block gardens to take up spraying, as it was believed that the disease appeared virulently every year if only isolated lots in a block were sprayed; in certain places where the disease had been virulent for some years, the Pest Act was enforced.

Experiments carried out over several consecutive years with a view to ascertaining the possibility of stamping out the disease in particular areas gave satisfactory results. The Kerodi garden

showed no traces of the infection for three years after the cessation of the treatment, in spite of being in close proximity to badly infected areas; in the fourth year, however, the disease reappeared on a few trees, and has been increasing since then, but not with its former virulence. After a few years of spraying the disease has been completely stamped out in the Agumbe garden; during the last eight years, following the cessation of the control work, not a single tree has been attacked, notwithstanding the fact that the garden is situated in an area of high rainfall, and in a locality where koleroga is at its worst.

No change has been found necessary in the formula of the spraying mixture as originally recommended by the Department [Coleman. Diseases of the areca palm. 1. Koleroga, *Mysore Dept. Agric. Mycol. Ser. Bull.*, ii, 1910], except in the amount of soda with which the resin is boiled; this quantity may vary from ½ to 1 lb. according to the nature of the soda. 'Blighty' Burgundy mixture did not give satisfactory results. The present cost of spraying 100 trees is from Rs. 2–12–0 to Rs. 3 [R. 1 = about 1*s.* 4*d*].

FULTON (H. R.). **Occurrence of Thielaviopsis paradoxa on the cocoa-nut palm in Florida.**—*Phytopath.*, xii, 8, pp. 398–399, 1922.

Sections of a diseased trunk of a coco-nut palm from Florida, examined in January 1922, showed extensive rotting of the ground tissue of mature parts, resulting in large internal cavities. The disintegrated part was dry and brittle, surrounded by a zone of recently invaded tissue which was brown and water-soaked. Cultures from the advancing margins of the decaying areas yielded almost pure growths of an organism agreeing closely with the description of *Thielaviopsis paradoxa*. The identity of the fungus was confirmed by inoculating healthy pineapples with pure cultures, which caused typical *Thielaviopsis* rot. *T. paradoxa* was readily recovered in pure culture from the artificially infected pineapple fruits and leaves.

The results of a series of tests indicated that 25° C. is the optimum temperature for mycelial growth in this fungus. At 15° C. there is distinct retardation, and at 10° C. visible development does not occur in twelve days.

FUNKE (G. L.). **The influence of hydrogen-ion concentration upon the action of the amylase of Aspergillus niger.** Reprinted from *Proc. Kon. Akad. Wetenschap. Amsterdam*, xxv, 1–2, 3 pp., 2 figs., 1922.

The action of the amylase produced in large quantities by *Aspergillus niger* does not appear to be unfavourably influenced by a high hydrogen-ion concentration of the nutrient medium. It was therefore assumed that the optimum concentration for the action of this amylase would not be found to be the same as the optimum for ptyalin, namely, an almost neutral or faintly acid reaction.

Preliminary investigations were made, equal amounts of enzyme solution from the nutritive liquid being mixed with buffer solution and 0·16 per cent. amylum solution. The hydrogen-ion concentra-

tion of this mixture was determined by the aid of colorimetric indicators, and the rate of hydrolysis of the amylum by the iodine reaction. It was found that there was no point of optimum action, but a broad optimal zone extending from P_H 3·5 to 5·5. No apparent influence was exercised either by the concentration of the amylase or the composition of the nutritive liquid. Amylase extracted from the mycelium gave the same results. The theory of Michaëlis, that the enzymes are ampholytes, is largely confirmed by these results.

The dissociation constant of the acid of the amylase of malt appears to be the same as for the amylase of *Aspergillus*, that of the base being larger, namely, $5{\cdot}76 \times 10^{-11}$. Thus as acids the two amylases are equally strong, as bases that of the malt is the weaker.

HOPKINS (E. J.). **The effect of lactic acid on spore production of Colletotrichum lindemuthianum.**—*Phytopath.*, xii, 8, pp. 390–393, 2 figs., 1922.

The author found that the addition of three drops of lactic acid to 20 c.c. of potato agar greatly increased spore-production in cultures of the β strain of *Colletotrichum lindemuthianum*. In cultures containing two drops of acid a few pustules were observed, while the addition of only one drop caused no appreciable degree of sporulation. Spore-production in this species appears to increase with increase in hydrogen-ion concentration, while there is an accompanying decrease in the amount of vegetative growth.

BROWN (W.). **On the germination and growth of fungi at various temperatures and in various concentrations of oxygen and of carbon dioxide.**—*Ann. of Botany*, xxxvi, 142, pp. 257–283, 1922.

The object of the author's investgations was to examine the behaviour of fungi under similar conditions to those of fruit storage. Of the two methods of fruit storage known—cold storage and gas storage—the former is widely employed, while the latter is still in the experimental stage. The temperature employed in practice for cold storing fruits usually does not go below 2° to 3° C.; and for his experiments the author has taken 5° C. as his lowest temperature except in a few cases. The gas storage method is based on the retarding action of carbon dioxide on metabolic processes. In practice, the maximum feasible concentration of this gas is somewhat below 20 per cent., for the concentration of oxygen in the atmosphere of the store has to be kept at a certain level so as to avoid anaërobic respiration. In the experiments special attention has therefore been given to the concentrations admissible in practice.

The work of other investigators in similar fields is touched upon in the historical section of the present paper, and an account given of the methods followed in the course of the experiments. The results obtained indicate that the conclusion can be drawn that, within very wide limits, variation of oxygen pressure has little effect on the germination and growth of the ordinary fruit-rotting

organisms such as *Botrytis*, *Fusarium*, *Alternaria*, &c., no appreciable decrease in germination being shown until very low concentrations of oxygen—about 1 per cent.—have been reached. Even with a CO_2 concentration of 30 per cent., the oxygen content of air would still be 14 per cent. Hence, in practice, variations in the latter must be regarded as of negligible importance.

Carbon dioxide, on the other hand, retards the germination and growth of fruit-rotting fungi. This action is most marked at the lowest temperatures and in the weakest nutrient solutions, and is, to a lesser degree, dependent on the density at which spores are sown, greater density favouring retardation. Parallel series of germination tests—one in water and the other in a turnip extract made by extracting the juice of turnips boiled without any added water, and then diluted with water to one-fifth strength—showed that *Penicillium glaucum* is the most insensible of the fungi tested to CO_2, the concentration required to stop germination in the nutrient medium being 80 to 95 per cent., and in water over 30 per cent. This compares with 50 per cent. and 20 to 30 per cent. respectively for *Botrytis cinerea*, while *Aspergillus repens* required 40 per cent. CO_2 in the nutrient medium to prevent it from germinating. The time allowed for germination was seven days (the author considering this period sufficient for assuming complete inhibition if no germination had taken place by then), and the temperature was 15° to 18° C. In the case of *Rhizopus nigricans*, the spores of which, in 50 per cent. CO_2, showed universal germination, the germ-tubes, instead of being long, straight, cylindrical, and of uniform diameter, appeared as short, stunted structures, irregularly swollen. This is attributed to the formation of 'giant cells' ('*Riesenzellen*') due to acidity brought about by the high pressure of carbon dioxide. On being brought back to normal atmospheric conditions, these distorted germ-tubes resumed normal growth. This absence of permanent injury was observed in all the fungi treated with CO_2, as they germinated with their usual vigour and produced ordinary germ-tubes as soon as they were placed in normal atmospheric conditions.

The combined action of carbon dioxide and low temperature was tested upon (*a*) germination of the spores, (*b*) rate of growth of colonies on artificial media, (*c*) rate of growth of specific fungi on certain fruits. It was found that the inhibitory action of carbon dioxide is greatly increased by lowering the temperature. Even with the very resistant *Penicillium glaucum* a 10° C. drop from ordinary temperature, combined with 10 to 20 per cent. carbon dioxide, slows down the rate of growth of the germ-tube 6 to 9 times. Most of the measurements, however, were done not on germ-tube length, but on the diameter of plate colonies. It was found that the amount of retardation of growth is greatest in the earliest phases of growth and decreases with time usually up to a certain limit, but in some cases, at the higher temperatures, the carbon dioxide cultures overtake and may even pass those in air. This is due to partial neutralization by the carbon dioxide of the 'staling' which in these cases is associated with a development of alkalinity by the fungus.

As in the case of CO_2 action on germination, the retarding effect

of CO_2 combined with low temperature varies with different fungi, in roughly the same order in both cases.

When inoculated into fruit the same general results were obtained, but the additional factor due to the different degrees of parasitism of the fungi tried had an effect on the results. For instance, *Botrytis* is a weaker parasite on apple than *Monilia*, and one may suppose that living apple tissue is a poorer nutrient for the former than for the latter. All the results obtained are believed to be covered by the statement that the carbon dioxide retarding factor has greatest effect when the energy of growth is small. Hence one would expect that *Botrytis* is more readily retarded than *Monilia* on living fruit, and this is the case.

The general conclusion is reached that the gas storage method is most effectively used in combination with the ordinary cold storage method, and that it will give the best results when no attack of the fruit has begun previous to storage, and when conditions are such that a minimum of nutrient is available for spores on the surface of the fruit.

Graphs and tables are given of the rates of growth of a number of fungi at various temperatures and in various concentrations of carbon dioxide.

DICKSON (B. T.). **Diseases of the Potato.**—*Fourteenth Ann. Rept. Quebec Soc. Prot. Plants*, pp. 67–105, 12 figs., 1922.

This is a somewhat popular account of the diseases of the potato in Canada, reprinted from *Scientific Agriculture*. The diseases described are hopperburn, mosaic and mosaic dwarf, leaf roll, powdery scab (*Spongospora subterranea*), blackleg (*Bacillus atrosepticus*), wart (*Synchytrium endobioticum*), leak (*Pythium de Baryanum*), late blight (*Phytophthora infestans*), wilt and stem rot (*Sclerotinia libertiana*), scurf (*Corticium vagum*), early blight (*Alternaria solani*), wilt and net necrosis (*Fusarium oxysporum*), scab (*Actinomyces scabies*), skin spot (*Oospora pustulans*), silver scurf (*Spondylocladium atrovirens*), dry rot (*Fusarium* spp.), and black dot (*Vermicularia varians*).

The last-named is new to America. It was first discovered in France by Ducomet in 1908, and named 'dartrose', and was afterwards found in Australia and South Africa. The symptoms of the disease are a slight yellowing of the foliage, sometimes accompanied by dwarfing, followed by the withering of the leaves, and the development of minute, black sclerotia on the surface, especially of the lower part of the stem. Sclerotia are also found lining the inside walls of the vascular cylinder and covering the tubers. The roots and rhizomes are also attacked. The mycelium is found throughout the tissues, including the leaves when the latter bear sclerotia. In the tubers it is confined to the outer layers and does not cause serious damage. In the author's cultures the spores were slightly smaller than those described by Ducomet and the setae longer, while the sclerotia were not closed pycnidia as he states. Ducomet's spore-measurements were 18 to 22 by 2·5 to 3 μ and the setae 100 to 130 μ.

The fungus is stated to be also parasitic on tomato and *Physalis peruviana* in France. The author has artificially infected the

former. The disease is only serious in so far as it weakens the plants and thereby reduces the crop.

CRÉPIN (C.). **Une maladie grave de la Pomme de terre dans le nord de la Loire.** [A serious Potato disease in the north of the Loire Department.]—*Comptes rendus Acad. Agric. France*, viii, 30, pp. 803–806, 1922.

A serious disease of potatoes has recently been observed in various localities in the north of the Loire Department. The symptoms appear towards flowering time, when the topmost leaves begin to curl, followed by those of the middle and base of the stem. In hot, dry weather the plants are killed in a few days, desiccation beginning with the lower leaves, which droop down along the stem. In dull or damp weather the plants may live for some time, their curled leaves frequently leading to confusion with leaf roll or leptonecrosis, from which, however, the present disease may be distinguished by two main characteristics. The topmost leaves are the first to be affected, and they become soft, flaccid, and drooping; whereas in leaf roll the leaves at the base show the first symptoms, and they usually remain firm and upright. In cases where the plants live for some time after attack, the stems and leaves gradually lose their chlorophyll and assume a greenish-yellow tinge, while the axillary buds develop into more or less swollen axes.

On pulling up a diseased plant it will be found that the stolons, roots, and underground portions of the stem are attacked by a dry rot. The cortex is easily detachable, leaving the central cylinder exposed. Under the periderm may be seen a number of minute, black sclerotia, situated around the medulla of the base of the stems and even in the wood. They are also present on the stem up to several centimetres above soil level.

On the tubers are grey or discoloured patches which also bear sclerotia, smaller than those on the stem. This disease of the tuber was investigated by Ducomet in 1908, found to be due to the previously undescribed fungus *Vermicularia varians*, and named 'dartrose' [see preceding abstract]. Since that time the disease has not been reported in France, which suggests that the fungus may be only a facultative parasite. In any case the damage caused by it is extremely serious in the vicinity of Saint-Germain-Laval, where all the fields are attacked, and not a single plant is immune. The yield is considerably reduced and many of the tubers are soft.

It will be necessary to institute a series of experiments during 1923 to test the resistance of the better-known commercial varieties, great care being taken to distinguish between what may be termed 'flaccid' leaf roll and the true disease of that name.

LACHAINE (O. W.). **Sclerotial disease of the Potato.**—*Fourteenth Ann. Rept. Quebec Soc. Prot. Plants*, pp. 105–109, 6 figs., 1922.

During 1921 the writer found 10 per cent. of sclerotial disease in a four-acre field of potatoes in New Brunswick, and 1 to 2 per cent. in four other fields. A blackish zone was found extending upwards from the soil for about five inches, giving the plants the appearance of blackleg. The cortical tissues were easily removed by rubbing. Three weeks later the outer necrotic tissues were

dried out and the leaves yellowed. Abundant sclerotia were found in the place of the pith. After a month's freezing, followed by sterilization in mercuric chloride 1:1,000 and washing in sterile water, cultures were obtained from the sclerotia. No apothecia were observed.

Greenhouse experiments showed that the earliest signs of the disease are patches of whitish mycelium on the outside of the potato or tomato stem, at the point of infection level with the surface of the soil. In damp weather profuse mycelial growth occurs, with a subsequent development of external sclerotia, which are whitish at first, afterwards turning black and falling to the ground. The mycelium gradually penetrates to the pith, where rapid growth takes place with the formation of the internal sclerotia.

Inoculations on potato and tomato plants caused the destruction of the cortical tissue of the latter two inches above soil level, and wilting of the plant. The tissues of one potato plant were destroyed to a height of three-quarters of an inch, and half the circumference of the stem; on another the mycelium spread no farther than the tissues at the place of inoculation.

The fungus cannot be certainly identified in the absence of apothecia, but appears to be identical with *Sclerotinia libertiana*, Fcl. The only effectual control measures are the destruction of diseased material and crop rotation.

LUTMAN (B. F.). **The relation of the water pores and stomata of the Potato leaf to the early stages and advance of tip burn.**—*Phytopath.*, xii, 7, pp. 305–333, 9 figs., 1922.

The type of tip burn here studied is that associated with hot, dry weather and clear, brilliant sunshine, and is entirely distinct from that due to leaf-hopper injury. The work was carried out in Vermont, where leaf-hoppers are very rare.

Hydathodes have long been known to occur in the potato leaf, but no accurate study of them has been made. They occur on all margins, but are most frequently found toward the tip of the leaf. In structure they are not unlike stomata; the guard cells are larger, but otherwise identical, and they open and close in the same manner. The water cavity is larger, and opens directly on the vessels of the marginal vein, which is very highly developed and very characteristic.

Tip burn begins beneath the hydathodes, especially at the tips of the leaflets, the palisade parenchyma under the openings turning brown. The death of the tissues is probably brought about by excessive transpiration leading to extreme plasmolysis, and it proceeds backwards along the edges of the leaflet.

Poisonous substances (e.g. borax) are capable of being absorbed by the roots and producing a somewhat similar type of injury to that just described. In most cases of tip burn, however, the effect of poisons is likely to be secondary, but at times it is undoubtedly a primary factor.

The advance of tip burn into the leaf is explained as follows: The marginal vein, which probably plays an important rôle in equalizing the water-supply to all parts of the leaf, is liable to be killed under the influence of heat and intense sunlight. The result

would be that the vein would not be able to supply water to prevent the wilting and plasmolysis of the tissues towards the midrib. Cells plasmolysed beyond a certain limit die, whilst those less severely affected become yellowed owing to the destruction of chlorophyll. Experiments showed that severing the marginal vein in a number of places in hot, sunny weather led to tip burn.

The stomata are important in relation to the transpiration of water, and were therefore studied. The number of stomata on the upper side is much greater than usually supposed, the proportion to the total number on the leaf varying from one-third on the young leaves to less than one-fourth on the older ones. Tip burn seems to have little effect on the stomata or tissues under them.

The author is inclined to distinguish another type of tip burn with rather clearly defined edges, which is more of the nature of a scorch, and appears to be the result of excessive sunlight, as it may be reproduced in the laboratory with mirrors.

SHAPOVALOV (M.). **Rhizoctonia solani as a Potato-tuber rot fungus.**—*Phytopath.*, xii, 7, pp. 334-336, 1 pl., 1922.

Rhizoctonia solani has been found producing a tuber rot on abnormal tubers of the varieties Netted Gem and Burbank in the western United States. Only the abnormally elongated stem ends of these tubers, and occasionally knobs and eye ends, appear to be susceptible, a very peculiar jelly type of decay being produced.

The flesh of the elongated stem ends is deficient in starch and differs from the remaining tissues of the tuber by its watery and somewhat translucent appearance. If uninfected these stem ends shrivel up.

Tubers showing the jelly-like decay, carefully selected from healthy plants, yielded only *R. solani* in culture. Affected tissues in the first stage of the infection were nearly white, but as the decay developed they turned yellow and brown. This *Rhizoctonia* jelly rot does not usually advance beyond the elongated part of the stem end, the decayed portion being ultimately sloughed off or drying up and hardening.

Inoculations with *R. solani* on five abnormally elongated tubers all gave successful infections. Although this fungus appears to be responsible for jelly end rot in the present case, the possibility that other organisms, especially species of *Fusarium*, cause a similar form of decay (as maintained by previous workers) is not excluded.

RICHTER. **Der Einfluss von Rhizoctonia solani auf den Keimungsverlauf der Kartoffeln.** [The influence of *Rhizoctonia solani* on the germination of Potatoes.]—*Nachrichtenbl. deutsch. Pflanzenschutzdienst*, ii, 3, pp. 19-20, 1922.

Investigations on the germination of potato tubers of the varieties Wohltmann and Kaiserkrone, carried out at Landsberg in 1922, showed a high degree of infection by *Rhizoctonia solani*—35 per cent. in the case of Wohltmann and 40 per cent. in that of Kaiserkrone. The small, dark brown or black nodules on the skin, after swelling and becoming soft, sent out vegetative hyphae which generally extended over the surface of the tubers, where they formed a brownish network. In many cases this surface growth,

on reaching the newly-formed shoots, penetrated the latter, usually near the growing-point. Shoots thus infected turned brown and died. In a few cases the hyphae penetrated the older portions of the shoots first, generally from a lateral bud. The decay then appeared as a brown, scutiform spot, which gradually encircled the shoot and separated the upper, healthy part from the lower. The decay spread from infected to healthy shoots.

This disease was generally fatal, but occasionally particularly vigorous individuals managed to throw out new lateral shoots from buds situated below the decayed portion. The attacked tissues were completely rotted, and secondary infections by various bacteria frequently occurred. The fungus was isolated from the diseased tissues and formed sclerotia on various media. Out of the 68 Kaiserkrone tubers bearing *Rhizoctonia* scabs, the hyphae reached the shoots in the manner described above in 39, and of the 196 shoots borne by these 39 tubers, nearly 50 per cent. suffered from more or less severe rot. The resulting plants were poorly developed and their yield was reduced. The degree of infection was not lessened by germinating the tubers in dry, damp, or sterilized sand.

Kartoffelkrebs. [Wart disease of Potatoes.]—*Nachrichtenbl. für deutsch. Pflanzenschutzdienst*, ii, 10, p. 84, 1922.

The introduction of wart disease [*Synchytrium endobioticum*] into the small holdings of Berlin and its suburbs has led to the disease rapidly assuming the character of an epidemic, especially in the case of the Wohltmann variety. The infection dates back at least three years. At Dahlem a garden of about one acre in extent is completely infested, while neighbouring properties, separated by streets, appear to be still clean. The locality from which the infection was introduced has not yet been ascertained.

Poole (R. F.). **Recent investigations on the control of three important field diseases of Sweet Potatoes.**—*New Jersey Agric. Exper. Stat. Bull.* 365, 39 pp., 10 figs., 1922.

The loss from stem-end rot or yellows, a disease which can be caused either by *Fusarium batatatis* or *F. hyperoxysporum*, may amount to 65 per cent. or more in some parts of New Jersey, and is increasing in virgin soils. The Yellow Jersey is the most susceptible variety grown in the State, the Big Stem strains, the Red Jersey, and the Gold Skin varieties being more resistant. The so-called Southern Yams, such as the Porto Rico and Dooley varieties, are highly resistant under New Jersey conditions.

The vegetative mycelia of the fungi penetrate the fibro-vascular bundles of roots and stems, causing the wilting and death of the foliage. Dissemination is effected largely by the use of diseased seed-tubers and planting out infected cuttings, but soil, wind, water, animals, and manures are also involved. The selection of disease-free seed reduces the losses to some extent, even on severely infected soils. Some infected plants are very productive, yielding a large number of uniformly small tubers. Crop rotation over several years has failed to control the disease. Comparative trials with different fertilizers gave variable and inconclusive results in regard to the incidence of infection. Careful management of

the seed-beds is very important. After a large leaf surface has developed, sufficient water should be given to prevent the hardening of the stems. Sprouts should be set in the field before the hardening of the stems and general stunting takes place.

Ground rot, 'pit', or 'pox' (*Cystospora batata*) is severe in one isolated area in New Jersey, infection ranging up to 85 per cent. In other States this disease is also generally restricted to particular areas. In the locality referred to the disease has spread only a few miles in over thirty years. Soils that pack and harden after rains are favourable to the development of the organism. Large and small roots are attacked with equal severity. The growth of the stems may be shortened as a result of the attack on the feeding roots, the leaves lose their normal colour, and the yield is reduced. The disease does not spread in storage or on sprouts. Sulphur added to the soil at the rate of 200 to 400 lb. per acre is recommended for the control of the disease, and also has the effect of increasing the yield. The experiments in its use showed that sulphur applied directly round the plants caused injury to the roots, but that 300 to 400 lb. per acre of 'inoculated' sulphur [see this *Review*, i, 3, p. 82] can be broadcasted with advantage on infected soil about a month before planting. A higher proportion of nitrogen is recommended for infected soils than is usually applied to sweet potatoes.

Scurf or soil stain (*Monilochaetes infuscans*) causes an average infection of 50 per cent. in New Jersey, and occurs even in virgin soils. Severely infected potatoes may lose more than half their weight in storage. The growth of the fungus is stimulated by organic manures, especially when applied in the row. Spores are formed best on a soil-extract medium. In storage the fungus spreads from healthy to diseased potatoes. The disease was slightly reduced by a combined application of lime and sulphur, while sulphur, 'inoculated' sulphur, and 'Bac-sul' were extremely effective. Inoculated sulphur applied at the same rate and time as in the last disease is recommended. The destruction of the fungus on the tubers may be effected by soaking the seed for eight to ten minutes in 1 in 1,000 corrosive sublimate. The use of infected tubers for seed should be avoided. Allowing a period of five years between successive sweet potato crops gave a slight decrease in infection in some cases, but in others no benefit was apparent.

SHAW (F. J. F.). **A diseased condition of Rice.**—*Agric. Journ. of India*, xvii, 2, pp. 152–154, 1922.

The author states that a diseased condition of rice, similar to that described in the United States under the name of 'straighthead' by Tisdale and Jenkins [see this *Review*, i, 3, p. 83], is not uncommon in India. He believes, however, that if the disease is due to lack of soil aeration, as held by these authors, it is not improbable that the deficit of oxygen is due to more complex causes than are suggested by them. The presence of decaying organic matter in the soil would at least suggest that bacterial activity may result in the production of toxins, and that the benefits of aeration are due rather to the oxidation of these toxins than to the direct supply of oxygen to the plant. Besides, the fact that in some parts of

India large quantities of green leaf are puddled into the soil is in contradiction to the view that decaying organic matter produces a soil condition injurious to rice. Straighthead resembles 'brusone' in its two chief symptoms, namely the feeble development of the fine root system and the lack of grain. Attention is called to the work of Brizi, who showed that a diseased condition of rice with root symptoms similar to those of 'brusone' is dependent on a deficiency in the supply of oxygen to the roots. While this is not considered to be sufficient to explain the occurrence of 'brusone', the author considers that a more extensive knowledge of the biochemical processes involved in the activity of the micro-organisms of the soil would be of value in postulating a general cause for this group of diseases.

Scientific Research Notes.—*Bull. Rubber Growers' Assoc.*, iv, 3, pp. 107–110, 1922.

The mycologists of the Malaya Research Branch of the Rubber Growers' Association report that *Kretzschmaria micropus*, which is commonly found associated with *Ustulina zonata*, may prove to be a dangerous parasite.

Young rubber trees in South India are reported by Ashplant to be affected by a die-back, caused not by *Diplodia*, but apparently by *Phytophthora meadii*. The symptoms are confined to the greener portions of the shoot, and the disease is arrested at the nodes. It was noticeable that the attacks were chiefly on the side of the plantation nearest to old rubber. It is suspected that the fungus may live over the dry season in the tissues, as McRae has shown to be the case with *P. meadii*, and the removal of all affected shoots at a point three-quarters of an inch below the diseased zone is recommended. Spraying may help to avert fresh outbreaks during the next monsoon. The effects of the disease being most serious on unbranched trees, leaf-pruning is advised as a means of inducing the trees to branch.

Contrary to the general belief in the efficacy of the scraping and tarring method in curing brown bast, a recent examination by Ashplant of an estate so treated showed 98 per cent. of disease, in spite of the unusual care with which the operation was conducted. In 75 per cent. of the cases, however, the affection was so superficial that a repetition of the treatment might eliminate it. The new tissues were highly laticiferous, the quantity of latex derived subsequent to scraping apparently equalling, if not exceeding, that obtained prior to the outbreak of disease, although trial tappings were not made.

Patch canker (*Phytophthora*) is far more prevalent in South India than in Malaya or the Dutch East Indies, probably on account of climatic conditions. Invasion of the cells by the patch canker fungus leads to the formation of a protective corky tissue. Under conditions favourable to the fungus (the excessive damp of the early monsoon) all the tissues outside the corky layer are destroyed, and in many cases the organism penetrates to the cambium, causing an open wound. Later in the season the course of the attack is modified by climatic changes, the dry, hot weather inhibiting the development of the fungus in the tissues. The chief

danger of patch canker is said to lie in the possibility of subsequent physiological disturbances which may end in brown bast.

DASH (J. S.). **Insectes et maladies.** [Insects and diseases.]—*Troisième Rapport Stat. Agron. Guadeloupe, 1920–1921,* pp. 14–16, 1922.

The previous season's drought was responsible for a large extension in Guadeloupe of the root disease of sugar-cane due to *Marasmius sacchari*, especially in the coastal regions; in some cases the crop of whole fields was almost destroyed. Sugar-cane mosaic does not seem to occur in this island. Diseased cacao pods examined at the station were found to be attacked by *Phytophthora faberi*; practical measures for the control of the disease are recommended. The only diseases of coco-nut palm observed during the year were a few cases of bud rot and one of stem bleeding disease (*Thielaviopsis paradoxa*).

Overbrenging van Gelestrepenziekte door insecten. [Transmission of yellow stripe disease by insects.]—Abs. of a paper by L. O. Kunkel in *Hawaiian Planters' Record,* xxvi, p. 58, 1922. *Arch. Suikerind. Nederl.-Indie,* xxx, 21, pp. 357–358, 1922.

The results of very careful experimental work in Hawaii showed that *Aphis sacchari*, transferred from mosaic to healthy sugar-canes, flourished and multiplied, but no infection was observed. Experiments were also carried out with *Aphis maydis* (*A. adusta*), specimens of which were transferred from diseased (mosaic) maize plants to healthy Lahaina sugar-canes. In twelve days the first symptoms began to appear, and by degrees most of the plants thus treated became infected with mosaic, the controls remaining healthy. This confirmed Brandes's observations that *A. maydis* was an agent in the transmission of yellow stripe or mosaic disease from maize to sugar-cane.

Negative results have hitherto been obtained from similar experiments with *Peregrinus maydis* (which is able, however, to transmit the disease from one maize plant to another), and *Perkinsiella saccharicida*. These investigations are still in progress.

The danger of direct transmission of the disease from cane to cane by *A. maydis* appears to be slight. The insect only lives for a few days on the sugar-cane, which cannot therefore take the place of a permanent host like maize. Indirect infection by means of other regular hosts of the insect, such as *Eleusine indica*, *Panicum crus-galli*, *P. sanguinale*, *Polytrias diverisflora*, &c., is more probable.

LEDEBOER (F.). **Gelestrepenziekte.** [Yellow stripe disease.]—*Arch. Suikerind. Nederl.-Indie,* xxx, 21, pp. 359–362, 1922.

The author states that a full report of the experiments on the transmission of yellow stripe (mosaic) disease of sugar-cane, carried out at the Cheribon Sugar Experiment Station, is in preparation. Meanwhile it is considered advisable to announce that *Aphis adusta* has been proved to be an active agent in this transmission. There is no actual evidence that *A. sacchari* is implicated, though at one stage of the investigations this seemed probable. In the

course of the experiments it was ascertained that *A. adusta* occurs much more generally in sugar-cane plantations than is usually supposed, especially on *Panicum colonum* and *Paspalum* (*Panicum*) *sanguinale*. These grasses, in which the virus of the disease persists for long periods, are capable not only of infecting the canes in their vicinity, but also serve as new sources of infection when the diseased canes have been removed. All such grasses should therefore be burnt or buried. The cultivation of susceptible varieties of cane, e.g. the Cheribon-Chunnee crosses, should be restricted to outlying districts, where they will not contaminate healthy plantations.

VAN HARREVELD (P.). **Gelestrepenziekte en bladluizen.** [Yellow stripe disease and green-flies.]—*Arch. Suikerind. Nederl.-Indie*, xxx, 16, pp. 261–262, and 17, pp. 262–264, 1922.

It was recently announced in the Java Press by the Cheribon Sugar Experiment Station that the yellow stripe (mosaic) disease of sugar-cane was an infectious disease transmitted by the agency of a green-fly, *Aphis adusta* (*A. maydis*). The exact cause of yellow stripe disease, which in Java assumes the form of partial chlorosis or mosaic, is still obscure, but this information will be of great service to investigators. It has been proved by American workers that the corresponding disease in Cuba, Porto Rico, and Louisiana can be transmitted by green-flies, but it is not certain whether the yellow stripe in Java is identical with the American form of the disease.

Two species of *Aphis* occur on sugar-cane in Java, viz. *Aphis sacchari* Zehntner and *A. adusta* Zehntner. The latter is much less common than *A. sacchari*, and is frequently concealed between the expanding leaves of the young shoots. It has not yet been observed on sugar-cane in the gardens of the Java Sugar Industry Experiment Station at Pasoeroean, although yellow stripe disease is prevalent there. The suppression of *A. adusta*, which is common on maize, sorghum, and other grasses, would be no easy task, especially as it is so readily concealed. Other insects may also be involved. In any case the method of selecting healthy canes from the young setts is not likely to be superseded by this new discovery. Canes of the Chunnee variety have been known to suffer from yellow stripe to the extent of 100 per cent. in the absence of any contact with grass or green-flies. This susceptible variety does not improve on being transferred to the mountains, but seems, on the contrary, to deteriorate. Other varieties liable to the disease are D I 52, 36, 213, 826, 979, 1499, 1507, 1547, and 2379 P O J.

SIGGERS (P. V.). **Torula ligniperda (Willk.) Sacc., a Hyphomycete occurring in wood tissue.**—*Phytopath.*, xii, 6, pp. 369–373, 1 pl., 1922.

The examination of logs of white ash (*Fraxinus americana*) from Tennessee and yellow poplar (*Liriodendron tulipifera*) from Kentucky revealed the dark, catenulate spores of *Torula ligniperda* scattered deeply in the wood. The fungus has been previously recorded in spruce, fir, oak, *Rhamnus cathartica*, and *Erica arborea* in Europe, and in maple, basswood, *Tsuga canadensis*, and red gum

in the United States. In the laboratory the author grew it in cypress, white ash, yellow poplar, and cucumber tree.

The results of mechanical tests made on the yellow poplar and white ash logs, and a careful comparison of the values obtained with sound and infected test pieces, showed that in the former case the differences in these results could scarcely be correlated with the presence or absence of the fungus. In the white ash, on the other hand, all the infected logs except one had a lower specific gravity than the average for sound logs, while the logs, in which infection was readily apparent showed a marked decrease in strength values.

VRIEND (J.). **Stachytarpheta vatbaar door slijmziekte.** [*Stachytarpheta* susceptible to slime disease.]—*Vlugsch. Deli-Proefstat. te Medan* [Sumatra], 16, 4 pp., 1 fig., 1922.

The occurrence of slime disease (caused by *Bacillus solanacearum*) on *Stachytarpheta indica* in four different localities in Sumatra is reported. The plant is found at times in tobacco fields, and seeds freely in cultivated soils. The microscopic characters of the disease corresponded to those of slime disease in tobacco; a bacillus agreeing with *B. solanacearum* was found in the vessels, and an extract of the diseased tissues caused the death of inoculated tomato seedlings. An extract from these produced typical slime disease in young tobacco plants.

Stachytarpheta appears to be less susceptible than tobacco, possibly because of its more woody nature. There may be many other similar hosts of *B. solanacearum* amongst the weeds of tobacco fields, and if so they may have an important bearing on the perpetuation of the disease.

PALM (B. T.). **Verslag van het Deli Proefstation over 1 Juli 1920–30 Juni 1921.** [Report of the Deli Experiment Station from 1st July 1920 to 30th June 1921.]—*Meded. Deli Proefstat. te Medan-Sumatra*, Series II, 21, 72 pp., 4 figs., 1921 [1922].

The Botanical Department has been engaged in researches connected with the selection of tobacco in which disease resistance is taken into account. The question whether seed from plants affected by mosaic or slime disease (*Bacillus solanacearum*) inherits susceptibility to these diseases or not is also being studied. The available evidence does not yet admit of a conclusive statement on this subject, but it appears certain that the seed from mosaic plants does not produce a greater number of diseased seedlings than that derived from healthy plants. It has further been ascertained that a number of common Solanaceous weeds on tobacco plantations are also attacked by mosaic disease. *Physalis* and *Solanum* spp. are frequently affected and undoubtedly constitute a source of infection of tobacco. Mosaic also occurs on other plants, such as *Passiflora foetida*, *Jussieua* spp., *Cucurbita* spp., and various plants grown for green manuring, but it is not yet certain whether it can be transmitted to tobacco from plants belonging to other families.

Owing to the great difficulty of culturing the bacillus of slime disease it was necessary to find some other method of establishing its presence in the soil. Tomato seedlings, which are even more susceptible to the disease than tobacco, and grow more rapidly, were

sown on tiles in about 1 cm. of sterilized soil. When the seedlings attained a height of about 5 cm. and developed four leaves they were used for soil tests. An aqueous extract of the soil to be examined was made (1 kg. of soil to 1 litre of water), and the extract distributed as evenly as possible over the tomato seedlings. The roots were then cut with a sterilized knife, the controls being treated in exactly the same way, except that sterilized water was substituted for soil-extract. If the soil was sufficiently rich in *B. solanacearum* the symptoms of slime disease began to appear in the infected plants after three or four days. After six days in one test there was a total of twenty-seven infections from diseased soil, as against an entire absence of contamination in the case of 'healthy' soil and the controls. It was found that weaker concentrations of the soil-extract (the extract as prepared above diluted with one and with nine volumes of water respectively) resulted in a reduction of infection. Thus, out of 108 plants, twenty-five were infected after six days by the undiluted extract, while the lower concentrations gave seventeen and eleven infections respectively. This method has been very accurately worked out and should prove extremely useful in determining the intensity of the soil contamination.

Recent investigations, which are still incomplete, indicate that infection commonly takes place at the moment of lifting the seedling for transplanting. This explains the necessity of using only seedlings from healthy beds. Other tests have shown that from ten to fifty per cent. of the cases of slime disease in the field are attributable to the use of infected seedlings. Researches are also in progress concerning the period of incubation of *B. solanacearum*, and the breeding of a partially or totally immune strain of tobacco.

D'ANGREMOND (A.). **Die Bekämpfung von Phytophthora nicotianae in den Vorstenlanden.** [The control of *Phytophthora nicotianae* in the Vorstenland.]—*Meded. Proefstat. voor Vorstenlandsche Tabak*, xliii. [Abs. in *Zentralbl. für Agrikulturchemie*, li, 8, pp. 203–205, 1922.]

A number of samples of soil and manure have been analysed for the presence of *Phytophthora nicotianae* by the following method. The samples were stirred with water into a paste and spread on living tobacco leaves, which were covered with a layer of banana leaves. Twenty-four hours later the paste was washed off and the leaves preserved in tins for some days, when the spots were counted. The results showed that a large proportion of the stable manure used in the Vorstenland province was infected by *Phytophthora*. Comparative tests showed that the use of manure giving a positive *Phytophthora* reaction, however slight, endangered the tobacco crop. Even with a negative test the danger was by no means absent. Control plots, on which stable manure was not used, showed a much lower proportion of infection. Disinfection of the manure with carbon disulphide was effectual, but too expensive. The results of treatment with copper sulphate were not satisfactory. The use of stable manure for seed-beds is therefore very undesirable.

There are other secondary channels of infection, such as the water

flowing from old tobacco fields to new ones, the floors of store-houses, &c. The practice of planting out seedlings between the existing rows of tobacco plants should also be avoided.

VALLEAU (W. D.) & KINNEY (E. J.). **Strains of Standup White Burley Tobacco resistant to root rot.**—*Kentucky Agric. Exper. Stat. Circ.* 28, 16 pp., 6 figs., 1922.

Root rot (*Thielavia basicola*) causes very serious losses to Kentucky tobacco growers, and pure line selection work has therefore been undertaken with a view to developing resistant strains. Twenty-five resistant strains of Judy's Pride and Vimont Kelley White Burley Tobacco have now been tested, and about fifty other selections have been made from a Standup variety called Station Kelley. The results so far secured indicate that it is possible to obtain strains of White Burley which combine high quality with immunity from root rot.

CLINTON (G. P.) & MCCORMICK (FLORENCE A.). **Wildfire of Tobacco in Connecticut.**—*Connecticut Agric. Exper. Stat. Bull.* 239, pp. 365–423, 4 pl., 1922.

Tobacco wildfire (*Bacterium tabacum*) differs from all other leaf spot diseases in certain definite characters. Both in the seed-bed and the field, infected plants develop yellow discolorations in the green tissues, the spots usually being rounded and about the size of a finger tip. In the centre of the spots is a small point of white to brownish, dead tissue, which gradually encroaches on the yellow discoloration. The latter then becomes limited to a narrow, encircling band, or halo. In severe cases a large part of the leaf surface may be killed, and damage up to 60 or 70 per cent. has been estimated to occur in a number of fields. The symptoms of the disease in advanced stages resemble sun scorch or the so-called rust following calico. The yellow halo rings, however, generally persist to the end.

An examination of specimens of tobacco from Rustenburg, South Africa, convinced the writers, in spite of the recently published statement to the contrary [see this *Review*, i, 11, p. 376], that the disease in that country was identical with wildfire in the United States. Inoculation experiments with a water extract of crushed infected tissues sent from South Africa in January 1922 proved unusually successful. It is suggested that a more careful comparison of angular spot and wildfire is required. In the United States wildfire has been reported from North Carolina, Virginia, Maryland, Massachusetts, Kentucky, Tennessee, Wisconsin, Georgia, Pennsylvania, Vermont, Florida, and possibly South Carolina. It was first recognized in Connecticut in 1919, and was probably introduced with seed, though possibly in matting, fertilizers, or other imports from some infected area.

Previous workers have held that the disease is seed-borne, but the writers' own experience does not suggest that the seed is the chief source of annual infection in Connecticut. There seems to be no doubt that the seed-pods are liable to infection under favourable conditions, while healthy seed may also be contaminated by dust laden with germs. One of the most frequent methods of spreading

the disease is the planting of seedlings from infected fields. Other probable agents of dissemination are implements, the old tent-cloth used for seed-bed coverings, insects (especially flea-beetles), wind and rain, and the workers passing from one field to another.

It is not known how long the germs of the disease can remain attached to the dry seed and retain their viability, but it is assumed that the organism may overwinter on one-year-old seed so as to reinfect the next year's seedlings. It is very unlikely that the germs retain their viability as long as the tobacco seed, which germinates fairly well when eight to ten years old. Possibly the germs may overwinter in old canvas, in the soil, or in tobacco refuse.

In May 1921 the senior writer examined some seedlings which showed symptoms of rotting and shrivelling at the tips or upper edges of the leaves. Under favourable moisture conditions the plants ultimately shrivelled up altogether, leaving vacant patches in the beds. In less severe cases the rotten tissues fell away, leaving the rest of the leaf apparently healthy. Masses of bacteria were found in certain intercellular spaces in the rotten tissues. The general appearance of the seedlings resembled that of plants attacked by the damping-off fungi. About a week later these and other plants at a somewhat more advanced phase of growth showed the typical halo spots described above. The wet rot was evidently the first stage of the wildfire disease, not hitherto described. Probably the first leaves of very young plants come into contact with the soil, whence the wildfire germs may penetrate into the intercellular spaces through the large stomata at the tip or margin of the leaf. The second stage of the disease is the halo or yellow spot referred to above, and the third stage, which does not usually occur until the seedlings have been transplanted into the field, is the death of the healthy tissues between the spots. Plants left in the infected seed-beds are apparently not subject to a progressive form of the disease, partly on account of the reduction in moisture accompanying the removal of the covers, and partly because of the slow growth of the thickly set plants, which checks the spread of infection.

Cold, wet weather favours the development of the disease, which is always particularly serious when rain-water stands on the leaves. For this reason glass is a better protection to the seed-beds than cloth, and it also facilitates airing the beds. The latter should be lightly watered, preferably in the early morning or late afternoon. The Broadleaf, Havana, Cuban, and Round Tip varieties are all susceptible, especially the two former. As all Connecticut tobacco is grown for wrappers, the leaf injury results in much greater loss than in localities where the leaves are used for other purposes.

Southern investigators lay great stress on seed treatment for the control of the disease, but the writers question the importance of this measure in the north. Experiments in Connecticut with formalin (1 oz. to 1 pint of water for 15 minutes), and corrosive sublimate (1 part to 1,000 of water for 15 minutes), recommended by Fromme [see this *Review*, i, 3, p. 94], have resulted in the death of some of the seed, especially with formalin. Where the seed is suspected to have come from a diseased crop, disinfection with corrosive sublimate should be carried out. Steam sterilization of

infected soil at a pressure of 100 lb. for 30 minutes before the next year's planting is recommended. Spraying the seedlings with Bordeaux mixture, 4–4–50, and lead arsenate, has given excellent results and was not found to injure the plants appreciably. The first application should be given when the seedlings have just taken root, the largest leaves then being about the size of a thumb-nail, and the spraying should be continued every week thereafter until the end of the transplanting season. The writers believe this to be the only remedy which prevents the spread of wildfire in a bed, no matter what the source of its introduction. For the field crop the removal of infected leaves once or twice shortly after the plants have started to grow may somewhat reduce infection, and in some cases, if the infected plants are still small, ploughing up and resetting with new seedlings may be recommended. Such cases must be left to the discretion of individual growers. The greatest care should be taken to transplant out only plants absolutely free from the disease; if this is done, the grower has usually little to fear in regard to the field crop. After pulling the plants for transplanting, infection may spread from diseased to sound plants, especially if left wet in baskets overnight before planting out. Aerial spread from a distance into isolated fields planted with healthy seedlings does not appear to be common. Spraying the field crop is not believed to be practicable on account of the cost and the unknown effect of the spray on the quality of the mature leaf. Nitrogenous fertilizers promote rapid, watery growth and thus indirectly favour the development of the disease. Potash has been recommended as tending to increase resistance by promoting a hardier growth.

Cultures of *Bacterium tabacum* are fairly easily obtained from the wildfire spots on tobacco leaves, the organism being isolated with equal facility either from the dead centre or the yellow halo. There are certain discrepancies between the characters attributed to the organism by Wolf and Foster (*Journ. Agric. Res.*, xii, pp. 449–458, 1918) and those observed by the present writers. The former give the dimensions as 2·4 to 5 by 0·9 to 1·5 μ, the latter as 1·3 to 2·5 by 0·6 to 0·8 μ. The writers also found one to four or even five flagella, Wolf and Foster only one. The dimensions of *Bacterium angulatum*, the cause of angular leaf spot, are stated to be 2 to 2·5 by 0·5 μ, the number of flagella ranging from three to six. These particulars do not differ widely from those of *B. tabacum* as observed by the present writers, and may account for the prevalent confusion between the two diseases.

By puncturing the tissues infections were easily secured in the leaf parenchyma, ribs, or stems of growing greenhouse plants, especially young plants. In general, young, recently isolated cultures were more virulent than those several months old that had been frequently subcultured. In nature, however, infection undoubtedly takes place as a rule through the open stomata. The writers have not observed the occurrence of wildfire on any weeds or plants in or near tobacco fields, and their inoculations on tomato and other related plants were also unsuccessful. It is stated, however, that Chapman and Anderson (*Mass. Agric. Exper. Stat. Bull.* 203, p. 74, 1921) inoculated petunia, eggplant, and pokeweed

(Phytolacca decandra) by spraying with suspensions of the bacteria in water, and also isolated the wildfire organism from spots on tomatoes growing in an infected tobacco seed-bed. The organism can remain alive in dried leaves for about a year, but not much longer. It can live in the soil for short periods, and there are indications that it overwinters in soil at times.

A full bibliography of thirty-four titles is appended.

GARDNER (M. W.) & KENDRICK (J. B.). **Overwintering of Tomato mosaic.**—*Botan. Gaz.*, lxxiii, 6, pp. 469–485, 1 pl., 1922.

Tomato mosaic might conceivably be carried over winter in Indiana by means of hot-house tomato crops, in tomato seed, in related perennial weed hosts, or by insects. Hot-house tomatoes do bear mosaic during the winter, but are not widely grown, and will not account for the widespread appearance of mosaic in the tomato crop in the fields. In a total of 22,944 tomato plants grown from seed from mosaic plants, no evidence of seed transmission of the disease was obtained. Previous workers have not found that aphids carry it through the winter.

Perennial weeds were found to be important agents in the overwintering of the disease. It has been found in the weeds *Physalis subglabrata, P. virginiana, P. heterophylla*, and *Solanum carolinense*, and has been transmitted from each of these to the tomato. *P. subglabrata* carries mosaic over winter in its rootstocks, and the symptoms appear on the young shoots in the spring. This weed is very prevalent in Indiana. Mosaic does not commonly occur spontaneously in *Physalis* weeds, but infection was common when these weeds grew in fields which had grown tomatoes, and was found to have spread to them over a distance of 200 to 400 ft. from the tomatoes. Aphids, and apparently also flea-beetles (*Epitrix cucumeris*), may serve to distribute the mosaic.

Mosaic has been transmitted from tomato to the annual plants *Solanum nigrum, S. integrifolium*, and *Lycopersicum pimpinnellifolium*, but not to *Datura stramonium*. It has also been transferred from tobacco to tomato, and has been noted on cultivated *Physalis pubescens*. Susceptible annual weeds may aid in the spread of the disease during the growing season.

Solanaceous weeds, especially the perennial ones and those in and near tomato-plant beds early in the season, should be eradicated as a control measure against mosaic.

PRITCHARD (F. J.). **Development of wilt-resistant Tomatoes.**—*U.S. Dept. of Agric. Bull.* 1015, 18 pp., 10 pl., 1922.

Tomato wilt (*Fusarium lycopersici*) causes an estimated annual loss of over 115,000 tons of tomatoes in the Middle Atlantic, Gulf, and lower Mississippi Valley States, and is also prevalent in the Ohio River Valley, California, and parts of Colorado and Utah. The only reliable means of controlling wilt (the symptoms and effects of which are briefly described) is the development of resistant varieties.

From 1915 to 1919 the writer was engaged in an attempt to breed resistant strains. The original selections were made from the worst wilt-infested fields that could be found, and pure line

selections from these were tested by repeated plantings on infected soil. The resistance of the strains was graded by a combination of characters correlated with the degree of infection, namely, the percentage of infected plants, the percentage of dead plants, and the yield of fruit.

The only commercial varieties combining natural resistance with size and quality of fruit were found to be Duke of York and Buckeye State, which the author regards as virtually identical. Livingston's Globe was somewhat resistant, but besides being very susceptible to nail-head rust (*Macrosporium* sp.), it is unsuitable for canning. Absolute immunity was not exhibited by any of the forty varieties tested during the period under review. In the 1915 test the Louisiana Wilt-Resistant showed the smallest percentage of plants killed by wilt and Willis the highest, but in subsequent years Duke of York and Buckeye State gave almost as good results as Louisiana. In 1918 The Marvel, Columbia, Norton, Arlington (these four being strains developed by the writer from the Greater Baltimore, Stone, and Merveille des Marchés varieties), Louisiana Red, Louisiana Pink, and Tennessee A 16–2 were almost free from wilt, while John Baer, Greater Baltimore, Stone, Royal Red, Delaware Beauty, Red Head, Early Jewel, and Bonny Best were almost destroyed by the disease. The Mansfield tree tomato was fairly resistant, but produced little fruit; the results of tests with the Success and Mississippi Girl varieties were conflicting.

Most varieties differ little in the wilt resistance of the individual plants within the variety. A few, however, showed great variability in this respect, and selections can be made from them that transmit a high degree of resistance. Most selected plants transmit to their offspring approximately the same degree of resistance possessed by the parent plant, though occasionally the character may be strengthened in the second selection. The process of selection is somewhat complicated by environmental factors, which cause a certain amount of fluctuation in the character of resistance. On an average, however, wilt resistance is less variable than tomato fruit characters, its stability being maintained under both continued and discontinued selection, and in a number of different localities.

Several very resistant strains have now been developed by the writer, and are of high yield and superior quality of fruit. Field tests have been carried out with them in various parts of the United States, and have given excellent results. These strains are described in detail.

CHAMPION (H. G.). **Notes on the death of Chir (Pinus longifolia) poles in the Almora plantations of Kumaon.**—*Indian Forester*, xlviii, 4, pp. 168–174, and 5, pp. 232–246, 1922.

Since 1916 the author has carried on investigations and collected all the available information regarding the extensive mortality in young *Pinus longifolia* grown from seed sown since 1875 in the Almora plantations, in the Himalaya. The disease was observed by Stebbing in 1908, and ascribed to the attacks of a weevil. This view is critically examined by the writer, who is satisfied that the insect is secondary to the real cause of the trouble. The same applies to the other insect pests found by the writer, full notes on

which are given. The deaths occur principally among trees of 1½ to 4 ft. in height, especially on dry and shallow soils, but in certain districts well-established poles of thirteen years old and 1 to 2 ft. in girth, growing in good soil, have succumbed on a large scale. Schistose rock is the foundation of most of these soils, and there is an abundance of grass, much of which is *Andropogon repens*. In one district the loss of plants under 1 ft. in girth amounted in 1918–19 to 2,055 and in 1920–21 to 930. In the course of three years a sample plot of trees, 1½ to 2 ft. in girth, has lost 25 per cent. of its dominant trees.

Three years is the normal period elapsing between the first symptoms and death. During this time the appearance of the crown remains quite normal, though removal of the bark may show that the cambium has been completely girdled for at least twelve months. The growth in height, the length and density of the needles, and the date of expansion of the buds are not affected by the disease. At length an abrupt change takes place. The twigs lose their normal brittleness and the foliage its bright colouring, and in a week or two the entire crown turns yellow and dry. There is usually a more or less copious exudation of resin from the basal parts of the stem, generally extending over a zone from ½ to 3½ ft. in height. In all cases death seems to be the final result of the resin flow, though one tree has survived since 1918. The cases are frequently, but by no means always, concentrated in patches. The advanced stage of the disease may be observed at almost any time of year, but the periods of maximum incidence are March to April, coinciding with the renewal of growth after the winter rest, and August, corresponding to the height of insect activity.

The primary cause of the disease is believed to be the fungus described by Barclay as *Peridermium complanatum* var. *corticola*. The writer, however, thinks that the fructifications on the needles are not due to the same fungus as those on the bark, their identity never having been demonstrated. They are here referred to, for convenience, as f. *acicola* and f. *corticola*. The former is extremely common, but appears to do little damage to its host. The bark form is less common in natural regenerations, but in the plantations may become severe. It sends its orange aecidia through crevices of the bark towards the end of the hot weather in May. External bleeding is not always caused, but a trickle of resin may be the first indication of an infection. An examination of the cortical tissues below the origin of such a flow revealed on one occasion a mycelium probably belonging to the *Peridermium*. Reduced resistance and the resin flux attract various injurious insects, which complete the destruction of the tree.

The general indications show that the fungus is prevalent enough to account for the damage. In a plot 100 ft. square, in one plantation, 77 out of 127 plants, 2 to 6 ft. in height, showed the fructifications of the *corticola* form, while f. *acicola* was present on all the trees. The fructifications of the former generally occur on the main trunk, 6 in. to 3 ft. from the ground, and are often confined to one side. Two cases were noted in which one or two branches became badly infested, swollen, and cankered; they finally dried

off without infecting the rest of the tree. In no case so far seen could the swellings and cankers sometimes found be attributed exclusively to the action of the fungus. Possible alternative hosts mentioned are *Crataegus* and *Rosa moschata*.

Drastic measures are necessary for the control of the disease. All trees showing signs of going off colour should be immediately removed and burnt, taking care to cut a few inches below ground-level. It is of the utmost importance to eradicate infected plants before the spores are shed. Any new sowings on a large scale should be made in uninfected areas. The plantations near Almora are isolated from other pine forests, so that the danger of external infection is small. Frequent inspections are essential, especially in April and May, the only months when the fungus is sure to be visible.

FAES (H.) & TONDUZ (P.). **Rapport annuel 1921. Station fédérale d'essais viticoles à Lausanne et Domaine de Pully.** [Annual Report for 1921 of the Federal Station of Viticultural Experiments at Lausanne and the Domain of Pully.]—Reprinted from the *Annuaire agricole de la Suisse 1922*, 20 pp., 7 figs., 1922.

The Cantonal Viticultural Station at Lausanne (Vaud) was in 1920 transformed into a Federal Station serving the cantons of Fribourg, Geneva, Neuchâtel, Ticino, Valais, and Vaud. The Station has as its objects the perfecting of the various methods of control used against the insect and fungous parasites of the vine: the prevention or cure of 'diseases' of wines, and the development of viticulture in the canton of Ticino, where a series of researches has been undertaken in collaboration with the Agricultural College of Mezzana. In addition to this work the Station is also carrying out a series of investigations in fruit growing. It is proposed to undertake the selection of the most suitable varieties of apple for dessert and cider-making respectively, in order to increase the desirable types and eliminate the inferior ones already in cultivation. Special attention will be given to different blends of varieties suitable for cider-making, and also to problems of cultivation, manuring, and the control of parasites.

The section of physiology and pathology deals, among other subjects, with diseases of the vine, fruit trees, and other plants, and the comparative efficiency of the various fungicides, &c., utilized in phytopathology, while that of viticultural chemistry and fermentation is concerned with the study of 'diseases' of wine and cider, the control of proprietary insecticides and fungicides, the selection of pure races of yeasts, and the general microbiology of viticulture and agriculture, in addition to more purely chemical problems.

A short account is given of the activities of the Station during the year. The results of the two chief inquiries of interest here have been separately published, and are noticed below.

FAES (H.), TONDUZ (P.), & STAEHELIN (M.). **La lutte contre le mildiou en 1921.** [The campaign against mildew in 1921.]—*Stat. féd. d'essais vitic. de Lausanne*, Pamphlet, 14 pp. [1922].

It would appear, generally speaking, that meteorological conditions during the last few years have been more favourable for

the control of [downy] mildew [*Plasmopara viticola*] than was the case during the period 1901–1917. In 1921 the writers carried out a series of observations in the vineyard of Pully, which is connected with the Federal Station of Viticultural Experiments at Lausanne. The incubation period of the fungus during the summer varied from seven to eleven days. The principal phases in the development of the disease are described, and a chart is given showing the variations in temperature and other meteorological conditions from May to the beginning of October. The season was very favourable to the development of the vine, and the damage caused by the fungus was therefore inconsiderable, except in the case of a few plots treated with inferior fungicides.

Attention is drawn to the difficulties encountered by the meteorological experts attached to the viticultural stations in warning growers of the necessity for treating vines. The system of forecasting attacks is based on the incubation period of the fungus, and, as the season advances, the successive invasions overlap and it becomes necessary to provide not only for the treatment of each fresh wave, but also for that of previous infections. Attempts to do this every time that the meteorological conditions are favourable for sporulation and infection usually lead to too many applications of fungicides being recommended.

Experiments were carried out with eleven preparations for the control of mildew, two of which, the Bouillie Villedieu and 'Burdigal', contained no copper. These two proved complete failures and need not be further considered. The results with the others are summarized below:—

Bouillie mixte (a commercial preparation containing sulphates of copper, nickel, zinc, and iron), 3 kg. of the mixed sulphates, neutralized with the corresponding quantity of milk of lime, per hectol. of water. The preparation was very effective, scarcely a trace of the disease being observed. The leaves fell in October. Kurtakol (a commercial preparation of colloidal copper), 500 gm. to 100 l. of water. Slight attacks of the fungus occurred, but the foliage remained in good condition till November. This preparation is worthy of extended trials. Neutral verdet [copper acetate], 1,000 gm., gelatine 500 gm., water 100 l. The attacks were very slight and the foliage well preserved. The adhesiveness of the mixture was very marked. Caffaro paste (a commercial preparation of oxychloride of copper), 1 kg. to 100 l. of water. The treatment was not begun till June, and the results were not altogether successful, several slight attacks occurring and the foliage turning yellow in the middle of September. Bordeaux mixture (3 per cent. copper sulphate) and casein (50 gm. per hectol.). This treatment was most effective, infection being reduced to a minimum. The copper adhered to the leaves unusually well, forming a coating which completely resisted the action of rain; it is not necessary to add more casein than the quantity given above. Bouillie Sanavigne (a commercial cupric mixture with casein), 1,000 gm. to 100 l. of water. Excellent results were obtained, mildew being almost absent. Sulfadhérent (a commercial preparation of lime and casein to be added to copper sulphate solution made by dissolving 3 kg. $CuSO_4$ in 100 l. water). The vines were well protected against

mildew, but in spite of the great quantity of caseined lime employed the adhesiveness of the preparation was no greater than in the ordinary caseined Bordeaux mixture. The consistency of the mixture is too thick and the spraying machines become clogged. Kukaka (a commercial caseined cupric mixture prepared in Zürich). Moderate protection against mildew. Insufficient resistance to the action of rain. Ordinary Bordeaux mixture (3 per cent. copper sulphate). Results satisfactory on the whole.

It is pointed out that the critical period in the development of the disease in the area referred to is from the end of May to the end of July. If during this period the oily patches of infection appear seven to ten days after a warm rain, vigorous measures should be taken to protect the sound foliage from infection.

FAES (H.) & STAEHELIN (M.). **Le coître de la vigne (Coniothyrium diplodiella) ou maladie de la grêle.** [The coitre (*Coniothyrium diplodiella*) or hail disease of the Vine.]—*Stat. fed. d'essais vitic. de Lausanne*, Pamphlet, 14 pp., 7 figs. [1922].

Coitre, livid rot, or hail disease of the vine is caused by *Coniothyrium diplodiella* Sacc., a fungus that has certain analogies with the black rot organism (*Guignardia bidwellii*) with which it is often confused. A brief account is given of the history and distribution of the parasite, which has been recorded from Italy, France, Austria, Hungary, America, Algeria, and Switzerland. The most comprehensive work on the disease is that of de Istvanffi (Études sur le rot livide de la vigne (*Coniothyrium diplodiella*), *Ann. de l'Inst. central ampélologique royal hongrois*, ii, 1902). The present article is intended only as a preliminary outline of the problems still demanding investigation, the most important of which are stated to be the following:—

In the vineyards of Latin Switzerland epidemics of livid rot generally occur only after a hailstorm, whereas in other countries they often take place independently of the latter. The reason for this is not yet clearly known, and requires investigation based on exact knowledge of the local conditions of climate and cultivation in the different areas affected. Even in Latin Switzerland every hailstorm is not necessarily followed by an outbreak of livid rot. It sometimes happens that hailstorms in July and August, months ordinarily favourable to the disease, do not bring on an attack, and the reason for this is, again, unknown. Furthermore, little is known as regards the treatment of livid rot. The practice of cutting the grape-stalk above the point of attack in order to prevent the spread of the fungus is lengthy and tedious, and can only be carried out over a limited area. Treatment with copper sulphate mixtures immediately after hailstorms does not appear to have much effect on the disease, but is usually recommended in the absence of anything better. The application of sulphur immediately before or after a hailstorm has also been advised, but without any scientific justification. All that is known is that the spores of *Coniothyrium diplodiella* are highly resistant to the action of copper salts.

The authors' own observations indicate that infection of the

grapes occurs through wounds inflicted by hail. The spores actually penetrate through these wounds and germinate in the interior of the grape. The mycelium ramifies quickly through the tissues of the fruit, extends down to the rachis, and from the latter reaches other grapes of the bunch. The damage is most severe on mature grapes, especially at the end of July and during August, owing to the high sugar-content of the fruit at that time. The fungus may begin its attack at any point on the bunch, never attacking all the grapes simultaneously. The first symptom of infection is the appearance of zones of different colours on the grape. The outermost zone is of a greenish-golden colour, and this is followed by a reddish-yellow and a brownish zone, the centre of the spot being livid in colour. Gradually the entire grape assumes the livid hue and becomes dotted with pycnidia varying in colour from greyish-white to rose-brown. At this stage the rot is a 'wet' one, and the grapes adhere loosely to the pedicels and are easily detached by the wind or any slight shock. Those that remain gradually become mummified, adhering very firmly to the stalk in this state and giving rise in the following year to new spores which perpetuate the disease. De Istvanffi estimates the average number of pycnidia on an ordinary-sized grape at 200, each containing about 80,000 spores, which retain their viability for nine or ten months under dry conditions. When the pycnidia are placed in a drop of water, the whole mass of spores exudes through the ostiole. Those given out by young pycnidia are mostly hyaline, those from the older pycnidia coloured; both kinds germinate readily in nutrient solutions, giving rise to a hyaline, septate mycelium with granular contents and numerous vacuoles.

Inoculations were carried out at Pully on the 5th August 1921 with spores from mummies of the previous year, kept dry in the laboratory until forty-eight hours before use, when they were placed in a warm, damp situation. Drops of water containing these spores were placed on Chasselas grapes which had been wounded with a scalpel. On 8th August the infected grapes showed the typical livid discoloration and the pedicels were turning brown and shrivelling. The next day the infection spread from the pedicels to the unwounded grapes. The pycnidia appeared on the surface two days later, and by the end of the month the infected bunches were almost entirely mummified. On the control bunches, which were wounded but not inoculated, there were slight evidences of *Botrytis cinerea*, but no livid rot. These results prove that livid rot is not caused by wounding alone, as, for instance, by hailstones, but the spores of the fungus must also be present, which was evidently not the case on the non-inoculated grapes in this vineyard. Further inoculation experiments were undertaken to ascertain whether infection could be produced through wounds on the leaves, peduncles, and shoots. The results were all negative so long as water was used to germinate the spores, thus agreeing with the practical experience of the local vine-growers, who have never observed livid rot elsewhere than on the grapes. It was noticed that the spores germinated much more readily in grape juice than in water, this fact being, no doubt, one of the reasons why wounds favour infection. Further attempts to inoculate leaves with spores sown in drops of grape juice were

successful, entry into the leaves probably occurring through the stomata. The minimum amount of sugar required for spore-germination was found to be about 0·01 per cent. With a nutrient solution containing 2 per cent. of sugar, germination was rapid and complete, but there was none when the sugar-content was only 0·001 per cent.

Experiments on the treatment of the disease are still in the preliminary stage. Applications, two hours after infection, of Bordeaux mixture (3 and 4 per cent. copper sulphate) and of potassium bisulphite (2·5 per cent.) gave promising results. A lapse of four days between artificial infection and treatment rendered the latter completely useless.

Der Referentenentwurf des neuen Pflanzenschutzgesetzes. [Extract from the new Plant Protection Order.]—*Deutsche Obstbauzeit.*, lxviii, 32, pp. 299–300, 1922.

The following is a summary of the new order regulating measures for the suppression of diseases and pests injurious to cultivated plants in Germany.

The Plant Protection Service is carried on by (*a*) the Biological Institute for Agriculture and Forestry at Dahlem, Berlin; and (*b*) local head-quarters of the Plant Protection Service in the various districts of the country. The establishment and maintenance of these local head-quarters and the organization and development of the Plant Protection Service in the different provinces is in the hands of the provincial authorities, but is carried out in accordance with regulations issued by the Minister of Agriculture and Food Supply. The authorities of the different provinces may unite for the execution of the order.

The diseases and pests to be dealt with, together with the means of control, will be announced by the Minister of Agriculture. The directions for treatment will be issued by the authorities in consultation with the experts of the Plant Protection Service.

On the occurrence or suspected occurrence of any such disease or pest, the occupier ['Besitzer'] of the infected land is to notify the proper authority within three days. The local head-quarters of the Plant Protection Service, on discovering the existence of a notifiable disease or pest, must provide for the immediate execution of the prescribed directions. In urgent cases they may issue special directions for control, immediately informing the Biological Institute that they have done so. In cases where the occupier does not agree with the findings of the local Plant Protection authorities, the verdict of the Biological Institute must be obtained and is final.

The occupier of the ground on which the disease or pest occurs is obliged to carry out, at his own expense, the directions issued by the local head-quarters, and to give every facility for supervision of the work by the proper authorities. He has the right to appeal against the directions, but the work is not to be suspended pending the hearing of the appeal.

In the event of the occupier refusing to carry out, or carrying out inadequately, the prescribed measures, the local head-quarters

may carry them out at his expense. He is not entitled to compensation for loss or damage resulting from the prescribed measures.

Duly authorized members of the inspection staff are entitled to enter private land, buildings, &c., and to remove samples.

The import of plants and parts of plants into Germany is already partly regulated by Orders issued on 16th January 1917 and 22nd March 1920. These Orders are not affected by the new Order, which further extends them.

The import into German territory of plants and parts of plants regarded as carrying dangerous plant diseases or pests, and the import of injurious pests and germs of disease is prohibited. The Minister of Agriculture shall determine what plant diseases, pests, and germs are to be regarded as dangerous, and also what plants and parts thereof are to be regarded as bearers of them. Importation of living plants and parts of plants is restricted to certain points of entry and requires an import-permit. The latter will be issued, subject to inspection of the consignment on arrival, in the following cases:—(*a*) consignments from countries with adequate plant protection legislation when the consignment is accompanied by a certificate of examination, signed by an official expert, and stating (1) that the contents of the consignment are free from diseases and pests which would exclude it from admission; and (2) that the consignment originated in a locality free from infection. (*b*) Consignments from countries with inadequate plant protection legislation in accordance with directions to be issued by the Minister of Agriculture and Food Supply. [The remainder of the Order deals mainly with the penalties attaching to infringements of the various sections.]

Décret du 21 décembre 1921, No. 15198, approuvant le règlement de la défense sanitaire végétale au Brésil. [Decree of 21st December, 1921, No. 15198, authorizing the regulation of sanitary measures for plant protection in Brazil.]—*Diario official*, No. 14, 18th Jan., 1922. [Abs. in *Bull. mens. des Renseignements agricoles et des Maladies des Plantes*, xiii, 5–6, p. 809, 1922.]

The decree prohibits the importation, commerce, and transit in Brazil of live plants or parts of plants attacked by diseases or parasites recognized as dangerous; of harmful live insects at all stages of their development; of cultures of bacteria and fungi injurious to plants; of soils and organic débris liable to contain, at whatever stage of development, cryptogamic, or insect, or other pests of plants, even if such material forms an integral part of living plants; and of boxes, sacks, or other packing-material having served for the transport of the above-mentioned products.

The Minister of Agriculture, Industry, and Commerce is further authorized to prohibit the importation of any vegetable product originating in countries where diseases and pests, the introduction of which would constitute a menace to home-grown crops, are prevalent.